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1980 NETWORK REVIEW

by

Michael Machler
Hal Robbins

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1980 NETWORK REVIEW

Introduction

The U.S. Environmental Protection Agency (EPA) requires Montana's Air Quality Bureau to conduct an annual review of the state's ambient air monitoring network. This report is the second in the series. EPA's requirements, as set forth in 40 CFR 58.20, are (1) to determine if the system meets the monitoring objectives defined in Appendix D of 40 CFR 58.20, and (2) to identify needed modifications of the network, such as termination or relocation of unnecessary stations or establishment of new stations that may be necessary. 40 CFR 58.25 requires the Bureau to develop and to implement an annual schedule to modify the network in order to eliminate any unnecessary stations or to correct any inadequacies indicated by the result of the annual review. The Bureau must consult with the Regional Administrator of the EPA during the development of the schedule to modify the monitoring program. The final schedule and modifications are subject to the approval of the Regional Administrator.

In order to conduct this review, the monitoring objective and spatial scale of representativeness of each station, existing or proposed, are first examined to determine whether they represent the area's air quality situation. Background information, such as maps, climatological summaries, emission inventories, traffic counts, and modeling results, are gathered and reviewed. The opinions of the Bureau staff, the personnel of three county air pollution agencies in the state, and staff members of the Helena EPA office also are solicited.

In the 1979 Network Review, the AQB designated each monitoring site in the State as either National Air Monitoring Stations (NAMS), State and Local Air Monitoring Stations, (SLAMS), or Special Purpose Monitoring Stations (SPM). The NAMS/SLAMS network is designed to meet four basic monitoring objectives: 1) to determine the highest concentrations expected to occur in the area covered by the network (concentration); 2) to determine representative concentrations in areas of high population density (population); 3) to determine the impact on ambient pollution levels of significant sources or source categories (source); and 4) to determine general background concentration levels (background). Each station in the NAMS/SLAMS network also is sited so that the air sampled is representative of certain spatial scales, which are defined as follows:

Microscale: defines the concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters.

Middle Scale: defines the concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometers.

Neighborhood Scale: defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range.

Urban Scale: defines the overall citywide conditions with dimensions on the order of four to 50 kilometers. This scale usually would require more than one site for definition.

Regional Scale: usually defines a rural area of reasonably homogenous geography and extends from tens to hundreds of kilometers.

National and Global Scales: these measurement scales represent concentrations characterizing the nation and the globe as a whole.

In order to site a monitoring station properly, both the monitoring objective and the spatial scale of representativeness must be determined. Appropriate siting scales for the various monitoring objectives are listed in Table 1.

TABLE 1

Monitoring Objective	Siting Scales
Highest concentration	Micro, middle, neighborhood (sometimes urban)
Population	Neighborhood, urban
Source Impact	Micro, middle, neighborhood
Background	Neighborhood, regional

The goal in siting stations is to match correctly the spatial scale represented by the sample of monitored air with the spatial scale most appropriate for each station's monitoring objective. During the process of the first network review in 1979, existing stations were evaluated for their monitoring objective and siting scale and, if necessary, the stations were modified. New stations established since then have been sited in accordance with the monitoring objective and siting scale determined in advance.

Total Suspended Particulates (TSP)

TSP is the most ubiquitous pollutant in Montana, affecting the entire state. Major sources of particulates include industrial activity, coal mines, unpaved roads, and agricultural activity. Table 2 lists estimated total particulate emissions by county. The highest particulate concentrations in Montana are found in urban areas such as Billings, Butte, Kalispell, and Missoula. Particularly in the western valleys, winter inversions allow particulate levels to increase and to remain high for days or weeks at a time. Some rural areas also show high particulate levels, due not only to agricultural activities and unpaved roads, but also to coal mines and other industrial sources.

All of Montana's TSP monitors are sited according to the neighborhood, urban or regional scale. (See Table 16). Selection of the appropriate siting scale is dependent on the station's monitoring objective. The monitoring objective for most stations is "population". In most cases, these "population" stations are sited according to the "neighborhood" scale, which corresponds to areas with dimensions from 0.5 to 4.0 kilometers. For those stations designed to determine the impact of particulate sources on ambient particulate concentrations, the monitoring objective is "source". Most of the particulate monitoring around air pollution sources is conducted by the companies responsible for the emissions, but the Bureau wishes to have at least one station in the vicinity. All "source" stations are sited according to the "neighborhood" scale. Several stations in urban areas are designed to monitor areas of highest concentration, and are sited according to the "neighborhood" scale. "Background" stations are chosen to determine concentrations of

particulates in areas remote from man-made sources. The Bureau considers that a minimum of two background stations is required in Montana, one in the eastern part of the state to characterize background concentrations in the plains, and another in a western valley for the mountainous portion of the state. Lindsay, in Dawson County, and Ovando, in Powell County, are stations that have been established for this purpose, and are sited according to the "regional" scale.

Appendix A to 40 CFR58 requires that at least two stations in the network be selected for duplicate sampling and that two samplers be co-located at these sites. Sites with the highest expected geometric mean concentrations must be chosen. Table 3 lists stations where the Bureau has co-located samplers.

Montana's network of NAMS stations for TSP consists of two stations selected from the SLAMS network. NAMS are required in urban areas larger than 50,000 population, which in Montana include only Great Falls and Billings. The TSP NAMS criteria are given in Table 4. Based on these criteria, both Billings and Great Falls fall into the "medium" concentration range and thus require one to two NAMS stations each. The Bureau has established NAMS stations at Taft School in Billings and at the public library in downtown Great Falls. The monitoring objectives of both these stations are "highest concentration" and "population", and both are sited according to the "neighborhood" scale of representativeness.

A statistical analysis was made for several TSP monitoring sites in Billings, Butte, and Missoula by the Air Quality Bureau. This analysis was conducted to determine whether any duplication of air monitoring stations exists, which in turn could lead to the elimination of dulicate sites.

In order to perform the analysis, a data file was created for four stations from each of the three cities of interest:

Billings: City Hall, Central Park, Grand Avenue School, Lockwood School;

Butte: Hebgen Park, Greeley School, Dr. Canty's Office, Floral Park; and

Missoula: Courthouse Roof, Lions' Park, McLeod Park, Rose Park.

For the Butte area, only the 1979 and 1980 data were used. The 1978 data were included in the analyses of the other areas. The data were created to evaluate matched data only; that is, data were selected from the master file such that a paired match was possible for any given day. The paired data were then organized into a file structure where statistical analyses were performed. The SPSS (Statistical Package for the Social Sciences) package on the state IBM 370 computer was used to perform all the analyses. A number of different programs was executed to reduce the data.

The analyses performed on the data were the calculation of correlation coefficients, frequency tables, and plotting of the data. The data are summarized in Table 5. Tables 6, 7, and 8 show the correlation coefficients among various sites for each of the three cities. Generally speaking, these tables were used to determine whether a station could be closed for statistical reasons.

It should be noted that the recommendations for maintaining or terminating a station cannot be made solely as a result of this statistical analysis, but must take into account such factors as future growth in the area of the sampling site, the pollutant concentrations at the site (especially if they equal or exceed the standards), and funding.

The results of the analysis for Billings are:

1. Lockwood School exhibits a poor correlation with nearly all sites.

Since it can be assumed the meteorology is similar throughout the entire Billings area, it is reasonable to conclude that there is a difference in emission sources among Lockwood School and the other sites (especially City Hall and Grand Avenue). If Lockwood School were being influenced by the same sources, it would be expected to have a good correlation coefficient. The Lockwood Site was operated in 1979 as part of the Montana Air Pollution Study (MAPS) and was closed in May 1980. As a result of this analysis, the Bureau recommends that it be reopened.

2. The correlation between Grand Avenue School and City Hall is very good, which may suggest that one of the sites is unnecessary. Figure 1 is a plot of the City Hall and Grand Avenue sites (monthly means) for the past three years. The plot shows that the two sites correlate rather well throughout the year with no major differences among the seasons. The Bureau does not recommend removal of either site, however, because of the historical value of the data.

In Butte, the results of the analyses indicated:

1. The correlation between Dr. Canty's Office and the Hebgen Park site is very good, which suggests that the two sites probably are affected by the same general sources and meteorology. The Dr. Canty site had a geometric mean of 62 for 1979, while Hebgen Park showed a 76. The Bureau recommends that both sites continue to be operated, because of the high concentrations found in these areas.

2. The Greeley School site generally exhibited a poor correlation with most of the other Butte sites. This, plus the high geometric mean of 79 for 1979 at this site, indicates that it should continue to be operated.

3. Floral Park appears to have the best correlation with all of the other sites. Since the geometric mean for 1979 at Floral Park was only 51, the Bureau recommends that the site be closed.

The analyses for Missoula indicated:

1. Rose Park and Lions' Park had an excellent correlation. The annual geometric means were very close in 1979 with 80 and 88, respectively. It appears, therefore, that both sites are measuring essentially the same type of emissions, and consequently it is not necessary to maintain both stations. The Bureau recommends that the site at Lions' Park be closed.

2. The Courthouse Roof site has a good correlation with all three Missoula sites. For two reasons, however, this site should remain: a) there is a significant difference in the seasonal distribution of the data, and b) the data from the Courthouse Roof is above the ambient standards with a 1979 geometric mean of 81.

3. The McLeod site yielded a good correlation with the Lions' Park and Rose Park sites, which suggests that the site may be unnecessary. Because of the high concentrations observed, the Bureau recommends that the site be operated for at least another year.

Modifications to TSP Network

For this report, each TSP station in the network was examined to determine whether 1) the monitoring objective and spatial scale of representativeness were appropriate for that station; 2) the designation of NAMS, SLAMS, or SPM should be changed; and 3) the station was an unnecessary duplication of another nearby station. Opinions of the Bureau staff were solicited to determine whether new stations were justified. Considerable public sentiment for more TSP monitoring was noted following the deposition of volcanic ash on the state after the Mt. St. Helens' eruptions, and this view has been taken into account.

As a result of the 1979 network review, several new TSP stations have been placed into operation in recent months. These stations have not been in operation long enough to determine whether they should remain in the network; they will be reviewed in next year's report.

The modifications to be made to the TSP network are:

1. St. Mary's (NAMS): change site designation to SPM, since EPA desires NAMS stations to be located in urban areas larger than 50,000 population.
2. Designate as SPM the new West Glacier site operated by the National Park Service, pending results of the first year's sampling.
3. Designate as SPM the Helena Valley Bank and Helena Capitol Courts sites operated by the Lewis & Clark County Health Department, pending results of the first year's sampling.
4. Laurel Farm site: relocate site approxiately one-half mile east of the present location and change designation from SPM to SLAMS.
5. Relocate Lindsay (SLAMS) site. This background station has shown violations of both state and federal standards, probably due to an adjacent dirt road and plowed field. It should be moved to a nearby site free of these influences.
6. Missoula Rose Park (NAMS): change designation from NAMS to SLAMS because EPA wishes NAMS stations to be located in urban areas larger than 50,000 population. Relocate site within park to meet siting criteria, since it is now too close to trees.
7. Missoula Lions' Park (SPM): close station.
8. Establish new SPM stations at Glendive and Thompson Falls, areas where a dearth of information during the volcanic episode, plus citizen interest in particulate monitoring, indicates a need for new stations.

9. Reestablish a station at the Lockwood School in Billings. The statistical analysis performed for this report indicated the need for a SLAMS station in the Lockwood area.
10. Close the Floral Park (SPM) site in Butte. Statistical analyses performed on this site indicated it duplicates other sites and therefore is not needed.
11. Close Colstrip BN (SLAMS) station because blasting in the vicinity impedes access to the site.
12. Establish a SLAMS station within the town of Colstrip.

Other Particulate Monitoring

In addition to high-volume samplers, the Bureau also uses membrane and dichotomous samplers to monitor particulates.

Membrane samplers are used to obtain a particulate sample for elemental analysis, and are particularly useful for this purpose due to the lack of background interferences found with other types of filters. The filters used are made of a teflon-related material with a pore size of three microns. Air is drawn through the filter by means of a large carbon-vaned pump. The airflow rate through the filter is approximately 0.12 m^3/min, or about one-tenth the flow through a high-volume sampler. The Bureau plans to discontinue regular operation of all its membrane samplers, although they may continue to be used from time to time for special purposes.

The dichotomous sampler splits particulates into two size fractions: less than 2.5 microns diameter, and 2.5 to 15 microns diameter. A number of these instruments have been operated during the last two years as part of the Montana Air Pollution Study (MAPS). Most of these have been discontinued with the end of the data collection phase of MAPS. The Bureau plans to operate one dichotomous sampler in or near each of the following cities: Anaconda, Billings, Butte, Great Falls, Missoula, Kalispell, Scobey, Columbia Falls, Polson, and Ronan.

TABLE 2

PARTICULATE EMISSION RATES BY COUNTY

County	Tons/Year
Flathead	83,687
Gallatin	81,132
Lewis and Clark	66,076
Missoula	54,345
Yellowstone	53,695
Ravalli	53,683
Cascade	51,529
Lake	48,455
Roosevelt	44,290
Fergus	42,225
Lincoln	36,480
Big Horn	35,092
Valley	34,956
Carbon	34,880
Powell	34,616

TABLE 3

CO-LOCATED HIGH VOLUME SAMPLERS

Site	Site
Billings	Taft School (NAMS)
Great Falls	Downtown (NAMS)
Butte	Greeley School (SLAMS)
East Helena	A&W (SLAMS)
Missoula	Courthouse Roof (SLAMS)

TABLE 4

TSP NATIONAL AIR MONITORING STATION CRITERIA*

Population Category	Concentration High	Medium	Low
High population 500,000	6-8	4-6	0-?
Medium population 100,000-500,000	4-6	?-4	0-?
Low Population 50,000-100,000	2-4	1-2	0

*Approximate number of stations per area

High concentration - exceeding level of the primary NAAQS by 20 percent or more.
Medium concentration - exceeding secondary NAAQS
Low concentration - less than secondary NAAQS

TABLE 5

Summary Statistics
Billings, Butte, Missoula

	Mean	Min	Max	Standard Deviation	Number	% of time above 260 ug/m^3
Billings						
City Hall	77.6	20	228	35.6	91	0.0
Central Park	95.8	13	247	55.0	55	0.0
Grand Ave.	67.3	4	302	47.1	91	1.1
Lockwood	72.0	17	353	67.2	46	2.2
Butte						
Dr. Canty	80.7	13	216	45.9	32	0.0
Hebgen Pak	87.1	18	183	42.6	25	0.0
Greely School	94.6	23	214	47.4	32	0.0
Floral Park	57.2	26	110	19.9	20	0.0
Missoula						
Courthouse	89.5	8	218	46.7	106	0.0
Lions Park	96.9	13	301	53.8	107	0.9
Rose Park	91.8	28	273	54.9	64	1.6
McLeod Park	123.2	25	283	69.5	26	3.8

NOTE: These summary statistics represent only the data used for the pair analysis. It does not represent the entire data set for 1978 and 1979.

TABLE 6

Correlation Coefficient
Butte

	Dr. Canty	Hebgen Park	Greely School	Floral Park
Dr. Canty Office	****	.859 (25)	.545 (32)	.823 (20)
Hebgen Park	.859 (25)	****	.608 (25)	.797 (16)
Greely School	.545 (32)	.608 (25)	****	.779 (20)
Floral Park	.823 (20)	.797 (16)	.779 (20)	****

Number in parenthesis represents the number of data pairs used to calculate coefficient.

TABLE 7
Correlation Coefficient
Billings

	City Hall	Central Park	Grand Ave.	Lockwood
City Hall	****	.861 (55)	.818 (91)	.561 (46)
Central Park	.861 (55)	****	.699 (55)	.797 (17)
Grand Ave.	.818 (91)	.699 (55)	****	.390 (46)
Lockwood	.561 (46)	.797 (17)	.390 (46)	****

TABLE 8

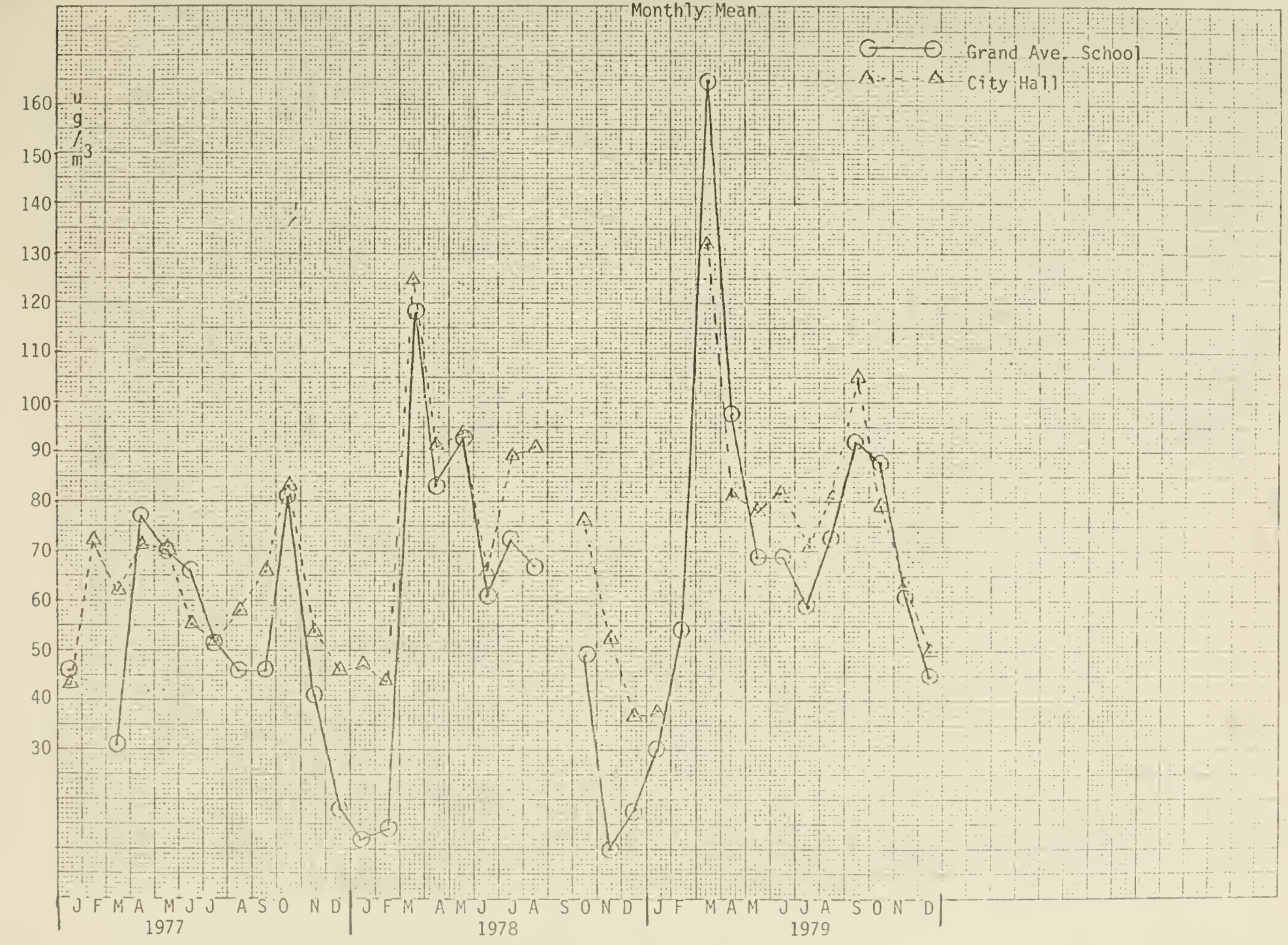
Correlation Coefficient
Missoula

	Courthouse	Lions Park	Rose Park	McLeod Park
Courthouse	****	.781 (106)	.795 (63)	.771 (25)
Lions Park	.781 (106)	****	.916 (64)	.879 (26)
Rose Park	.795 (63)	.916 (64)	****	.879 (26)
McLeod park	.760 (61)	.756 (61)	.829 (26)	****

Figure 1

TSP - Grand Ave. and City Hall (Billings)

Monthly Mean



Sulfur Dioxide (SO_2)

Sulfur dioxide emissions in Montana are due primarily to smelters, refineries, and coal-fired power plants. Table 10 lists SO_2 emissions for major sources. It has been the Bureau's policy to require the responsible industries to assume the major monitoring effort; however, the Bureau believes that in areas where state or federal standards are exceeded, the state should operate at least one site. Those areas that had violations of state and/or federal standards are Anaconda, Billings, East Helena, and Laurel.

The procedure for selection of SO_2 monitoring sites is first to determine the monitoring objective of the proposed station. Background information, such as meteorological data, emission inventories, and isopleth maps are then acquired. The general locations of the sites are determined, mainly by diffusion modeling, and finally, specific locations are selected so as to minimize undue influences from nearby sources.

The monitoring objective for the Bureau's SO_2 monitors is "source" and "highest concentration" at all sites. The spatial scales applicable to SO_2 NAMS and SLAMS monitoring are the middle, neighborhood, urban, and regional scales. In urban areas, the middle scale is the most likely to be representative. In suburban areas, the neighborhood scale is likely to be appropriate, while in rural areas, the regional scale is likely to be the most suitable. Sites to be used for air pollution episode monitoring should be middle or neighborhood scales, depending on the area likely to be affected. The Bureau wishes to use the neighborhood scale for its SO_2 monitoring, except for the Scobey area, where the regional scale is more appropriate.

Anaconda Area

The state presently operates one SO_2 monitoring station in this area (Lincoln School). The Anaconda Company operates SO_2 stations at Highway Junction, #2 Mill Creek, Opportunity, and the airport. In addition, the Company presently is installing new stations north of the smelter, on the Lost Creek road and near Galen (see Figure 11). These company monitors will be operated in accordance with the quality assurance requirements for SLAMS stations. The Bureau will conduct audits of these stations.

The Bureau considers that this network of state and company monitors is adequate and does not recommend any changes.

Billings area

The state presently operates SO_2 monitors at Taft School (NAMS) in Billings and at the Laurel Farm Site (SPM). In order to comprehend more readily the extent of SO_2 pollution in the area, the Bureau is about to undertake, in conjunction with area industries, a year-long study which will involve a network of four to seven monitoring sites (see Figure 12). The results of this study will be used to determine the extent of monitoring required. At the present time, therefore, the Bureau does not recommend any changes in SO_2 monitoring in Billings.

The Bureau has been operating an air monitoring site near the Cenex refinery in Laurel for approximately five years. During the past few months, Cenex has raised several of its stacks to approximately 61 meters. This structural change in the plant has reduced significantly the sulfur dioxide concentrations seen at the Bureau's Farm Site. The Bureau has conducted a model run for the Cenex refinery in an attempt to determine the best area to relocate the Farm Site.

There were three basic areas of concern in attempting to find the optimum location of any new site: 1) wind patterns; 2) atmospheric stability, and 3) air modeling.

Wind data from the national Weather Service and the Bureau's sites in Billings were used for this model run. Wind rose information from the National Weather Service station at the Billings airport indicates that wind direction in the area is predominantly from the southwest, with secondary maxima from the west-southwest and the northwest. The average wind speed in these directions is approximately three meters per second.

A number of wind roses also were calculated for the Bureau's Central Park site in Billings, and these indicated that wind direction is predominantly westerly with an average speed of approximately two meters per second.

Atmospheric stability was measured with an acoustic radar at the Vo-Tech site in Billings for approximately one year during 1978 and 1979. The stability data are summarized below:

Table 9

Month/Year	Most Common Stability	Second Most Common Stability
1978 September	D	E
October	E	D
November	E	D
December	E	D
1979 January	D	E
February	D	E
March	C	D*
April	D	C*
May	C	F
June	D	C*
July	D	E*
August	D	C*

*estimated

A simple rating system was applied to the data. Two points were given in the most common class and one point to the second most common. The results were:

D = 20

E = 11

C = 6

A simple Guassian plume model was applied to the Cenex Refinery using a Bureau program called "AIR0010." Since the purpose of the model was merely site selection, a number of simplifying assumptions were made:

1) All stacks were treated as one stack.

2) An emission rate of 100 g/sec was used. This is not to suggest that this is the actual rate, but this number was chosen only as a starting point. The data from the model, therefore, were screened only to find the maximum values and do not reflect actual data.

3) Stack height = 61 meters, stack diameter = 2 meters, exit velocity = 18 meters/second, exit temperature = 644°K.

4) The following combinations of stabilities and wind speeds were used:

Stability	Wind speed (m/sec)			
A	2	4	5	6
B	2	4	6	8
C	2	6	8	10
D	2	6	10	16
E	2	6	10	16

5) Since it generally is assumed that the sampler would be located within the valley floor, the same elevation was used for all points modeled.

6) The model was run for one through seven kilometers at one kilometer intervals.

The following distributions were noted within each stability group:

Stability

A Highest concentrations occurred at approximately two kilometers for all wind speeds.

B Highest concentrations occurred at one or two kilometers, depending on wind speeds.

C Highest concentrations occurred at five kilometers for low wind speeds and at two kilometers for six meter/second wind speeds and greater.

D Highest concentrations occurred at seven, six, four, and three kilometer distances.

E Highest concentrations occurred at six through eight kilometers.

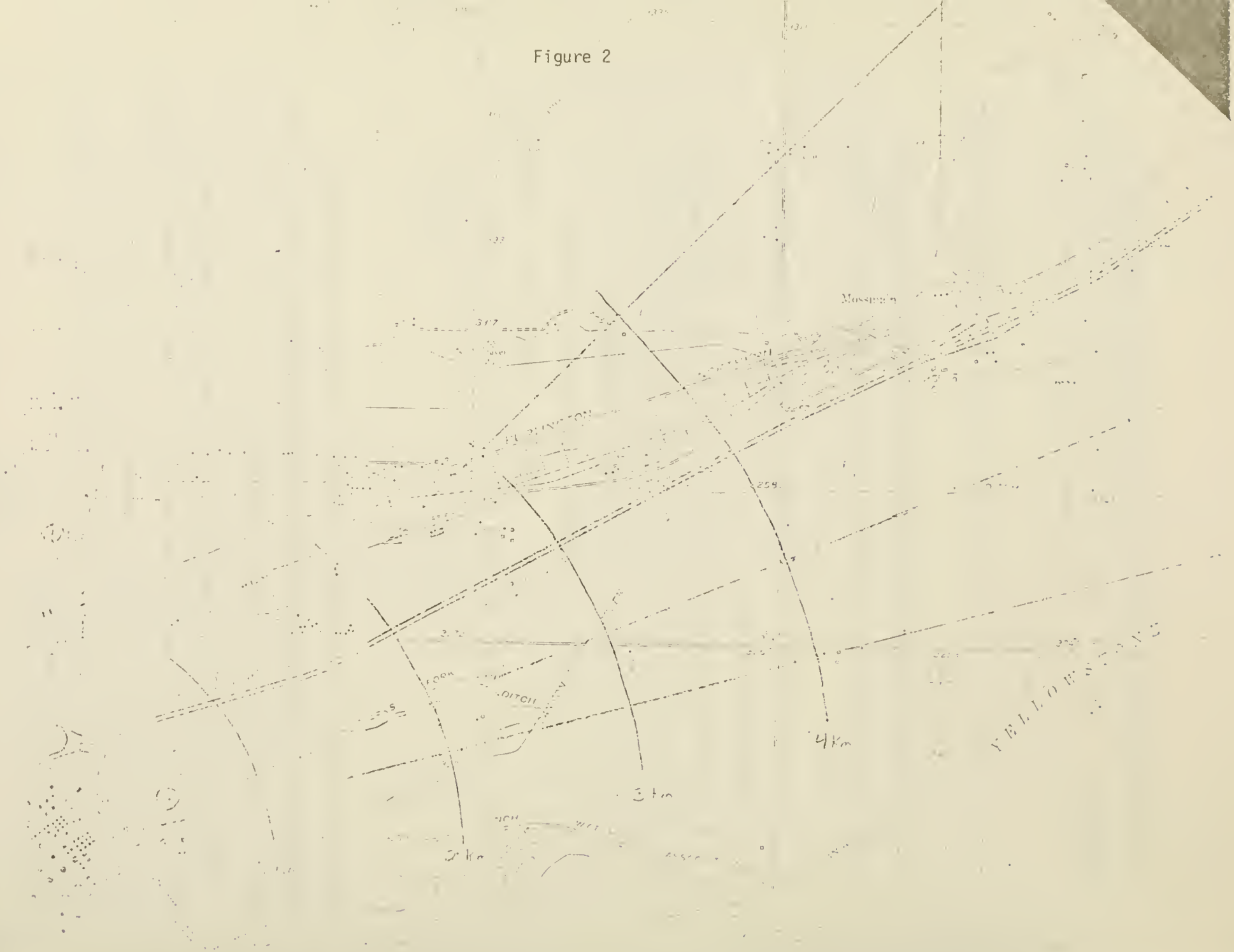
The highest concentrations for the entire run occurred as follows:

Concentration	Stability	Wind Speed	Distance
49	B	8 m/sec	1 km
47	B	6	1
40	C	6	2
40	C	8	2
37	C	10	2
36	B	4	2

These two data results are somewhat conflicting in terms of site selection, because the most frequently occurring stability class does not coincide with the stability classes with the highest concentrations.

Based on these data, the Bureau believes the best site location would be between one and three kilometers from the plant at a bearing between 45° and 75° east of north, because 1) the highest concentrations are predicted for this area; and 2) a large occurrence of the correct stability class exists to cause elevated sulfur dioxide readings.

Figure 2



East Helena Area

The primary source of sulfur dioxide emissions in East Helena is the American Smelting and Refining Company (ASARCO) lead smelter. As recomended in the 1979 Network Review, the Bureau has reduced its SO_2 monitoring to one site, i.e., the A & W site in East Helena. ASARCO is continuing to operate monitors at Kennedy Park, Water Tower, Kleffner Road, Broudy Ranch, Montana City, Microwave, East Station, Kleffner Ranch, and California Street.

The Bureau believes that the present monitoring network is adequate and does not recommend any changes.

Colstrip Area

Units 1 and 2 of Montana Power Company's (MPCo) coal-fired power plant emit sulfur dioxide from 500 foot stacks. Elevated concentrations of SO_2 are not expected in the area. The Bureau will continue to receive data from MPCo and to oversee company quality assurance practices.

Other Areas

The Bureau intends to establish sulfation plates near other sources around the state to acquire low-cost estimates of SO_2 concentrations. See Table 11 for a list of these sources.

Modifications to SO_2 Network

The Bureau recommends one modification to the SO_2 network: relocate the Laurel Farm Site (SPM) to a point between one and three kilometers to the northeast or east-northeast of the Cenex refinery.

TABLE 10

SULFUR DIOXIDE EMISSION ESTIMATES FOR 1977

SOURCE	SO_2 TONS/YR	COUNTY	CITY
Farmer's Union (CENEX)	10,380	Yellowstone	Laurel
Montana Power (Corette)	9,986	Yellowstone	Billings
Exxon Co., U.S.A.	9,800	Yellowstone	Billings
Continental Oil Co.	3,198	Yellowstone	Billings
Montana Sulfur	1,530	Yellowstone	Billings
Great Western Sugar	815	Yellowstone	Billings
Area Sources	2,007	----	----
Phillips Petroleum	1,807	Cascade	Great Falls
Westco	883	Glacier	Cut Bank
Area Sources	2,600	---	---
Anaconda Co. (Smelter)	281,750	Deer Lodge	Anaconda
ASARCO smelter	14,500	Lewis & Clark	E. Helena
Stauffer	208	Silver Bow	Ramsey
Anaconda Co. (Berkeley)	207	Silver Bow	Butte
Area Sources	596	----	---
Montana Power (Colstrip 1 and 2)	5,326	Rosebud	Colstrip
Montana-Dakota Ut.	2,372	Richland	Sidney
Holly Sugar	226	Richland	Sidney
Tumpane	174	Valley	Glasgow
Area Sources	596	---	---
Anaconda Aluminum	2,200	Flathead	Col. Falls
W. R. Grace Vermiculite	700	Lincoln	E. of Libby
Hoerner-Waldorf	365	Missoula	Missoula
St. Regis Paper	277	Lincoln	Libby
U. S. Plywood (Bonner)	224	Missoula	Bonner
Area Sources	3,282	---	---

TABLE 11

Static and Seasonal Pollutant Measurements

Location	Station	Fluoride			Sulfur Compounds
		Calcium Formate Papers	Sodium Formate Plate	Vegetation*	Sulfation Plates
Anaconda Aluminum					
	1. Anaconda S.	X	X		X
	2. Dehboms Res.	X	X	X	X
	3. Aluminum City	X	X		X
	4. Feirstein	X	X		X
	5. Teakettle #1	X	X		X
	6. Glacier N. Park	15(X) stations			
Stauffer Chemical					
	1. ESE Sta.	X	X	X	X
	2. Mt. Power Substa.	X	X		X
	3. Stauffer W.	X	X		X
	4. Ramsay N.	X	X	X	X
	5. Durant Canyon	X	X		X
Billings-Laurel					
	1. Laurel Fam	X	X	X	
	2. 1/2 mi. S. of Co-op	X	X		
	3. Two Moon Park	X	X		
	4. E. Conoco	X	X		
	5. Johnson & Lockwood	X	X		
	6. Exxon	X	X		
	7. Klenck Lane	X	X		
	8. Coburn Road	X	X		
	9. Piccolo *N Ft. Rd	X	X		
Anaconda Smelter					
	1. Highway Jct.	X	X		X
	2. Mill Creek	X	X		X
	3. Galen	X	X		X
	4. Warm Springs				X
	5. Fairmont	X	X		X
	6. Deer Lodge				X
	7. 3.5 mi, 11°E of N.				X
	8. 7.5 mi, 16°E of N.				X
	9. 8.0 mi., 29° E of N.				X
	10. 4.0 mi., 145° E of N				X
Great Falls					
	1. Philips Ref. N. 1	X	X		X
	2. Philips Ref. E.	X	X		
Sidney					
	1. New Site	X	X		X
	2. New site				X
Grant Kohrs			X		X
East Helena					X(6)

*Samples collected according to state techniques and samples monthly during the first weeks of May, June, July, August and September.

Carbon Monoxide (CO)

Automobile exhaust is a principal source of CO emissions, although some industries also emit CO, and agricultural burning also may be a source in some areas. In some western valleys, residental wood burning is becoming an important source.

Measured CO concentrations in Montana have never violated the federal one-hour standard, but numerous violations of the eight-hour standard have been noted in Billings, Great Falls, and Missoula.

Presently the Bureau operates CO monitors at the Malfunction Junction (intersection of Brooks, South, and Russell) and Downtown sites in Missoula, at the Great Falls Federal site on Tenth Avenue South in Great Falls, and at the Fairgrounds site in Billings. Four new CO monitors are currently on order, and they will be located at Thirteenth and Grand and a downtown site in Billings, Seventh and Main in Bozeman, and Idaho and Main in Kalispell. One or two of these monitors will be operated for about one year (beginning in 1981) at various locations throughout the state to screen potential problem areas.

Site selection for CO monitors begins by determining the primary purpose of monitoring. Once the determination is made, background information from climatological summaries, maps, and traffic counts is acquired (see Table 13). Neighborhoods or areas of the type desired are then selected and either diffusion models or plots of measured concentrations are used to select specific sites.

Missoula Area

Missoula, due to its valley location, experiences persistent inversions during the autumn and winter, resulting in poor dispersion of pollutants, including CO, during these seasons. The objectives for the Bureau's CO monitoring in this area are "highest concentration" and "population."

Since highest concentrations of CO generally are found near major

intersections during periods of poor atmospheric dispersion, a site at Malfunction Junction was selected several years ago for CO monitoring. The site has experienced numerous violations of the federal eight-hour standard, and the Bureau plans to continue monitoring at this location. The station is sited according to the "middle" scale of representativeness.

In order to measure highest concentrations to which people normally are exposed in the downtown area, a station (the Downtown site) was established at a mid-block location on the east side of Higgins Street, between Broadway and Main Streets. This station, sited according to the "middle" scale, was selected because high traffic volume and congestion indicated the area would experience the highest CO concentrations in downtown Missoula.

The increased use of wood-burning stoves for residential heating has led to an increase in CO concentrations in Missoula. High night-time concentrations have been measured at the Bureau's Lions' Park site during the past two winters, and it is thought that this was due to wood-burning stoves. Because of the location of the Lions' park monitor, traffic effects cannot be entirely discounted; for this reason, the Bureau has decided to close this station and locate a CO monitor at Rose Park. The Rose Park station, sited according to the "neighborhood" scale of representativeness, is relatively free of traffic influences close to the site, and hence should give a good indication of the CO concentrations due to wood-burning stoves.

The Bureau considers this network to be adequate for Missoula, and does not recommend further changes at this time.

Great Falls Area

The Bureau currently is monitoring CO at the Great Falls Federal site on Tenth Avenue South and 25th Street. The station, sited according to the "middle" scale,

was established to monitor CO along the Tenth Avenue South corridor, which EPA recently designated a non-attainment area for CO.

Great Falls, due to its excellent mixing conditions, does not experience CO problems of the magnitude encountered in Missoula or Billings. The Bureau does not believe any additional monitoring is warranted at this time; however, in the future, it may be desired to monitor in the downtown area.

Billings Area

The Bureau recently resumed monitoring of CO at the Fairgrounds site, located in the Fairgrounds-Metra complex. The monitoring objectives in this area are "population" and "highest concentration." It was felt that the "middle" scale of representativeness was most appropriate for the type of traffic corridor situation found in Billings. Results of modeling done in this area by PEDCo Environmental, Inc., for the Billings-Yellowstone City-County Planning Board (see Table 12 and Figure 3) indicated highest expected concentrations at a site near the intersection of Exposition Drive and First Avenue North known as Receptor Four). It was decided to locate the monitor about 700 meters north of this locaton, because 1) a site at Receptor Four would have to have been sited according to the "micro" scale of representativeness, while the Bureau wishes to site its CO monitors according to the "middle" scale whenever possible; 2) the Fair Board did not wish to have a site located in that area; and 3) Sixth Avenue North currently is being widened, which eventually will result in more traffic on that route during rush hours, leading to higher concentations in the area where the monitor is now sited.

In accordance with the 1979 Network Review, the Bureau plans to locate an SPM at Thirteenth and Grand in late 1981. In addition, funding permitting, the Bureau wishes to locate another SPM in the downtown area, near the former

TABLE 12

Hiway Model Results - Eight-Hour Concentrations*

Receptor	Concentration
1	3.1
2	13.2
3	3.4
4	15.7
5	2.3
6	8.8
7	1.7
8	7.9
9	2.7
10	11.6

*Based on modeling performed by PEDCo Environmental Inc.

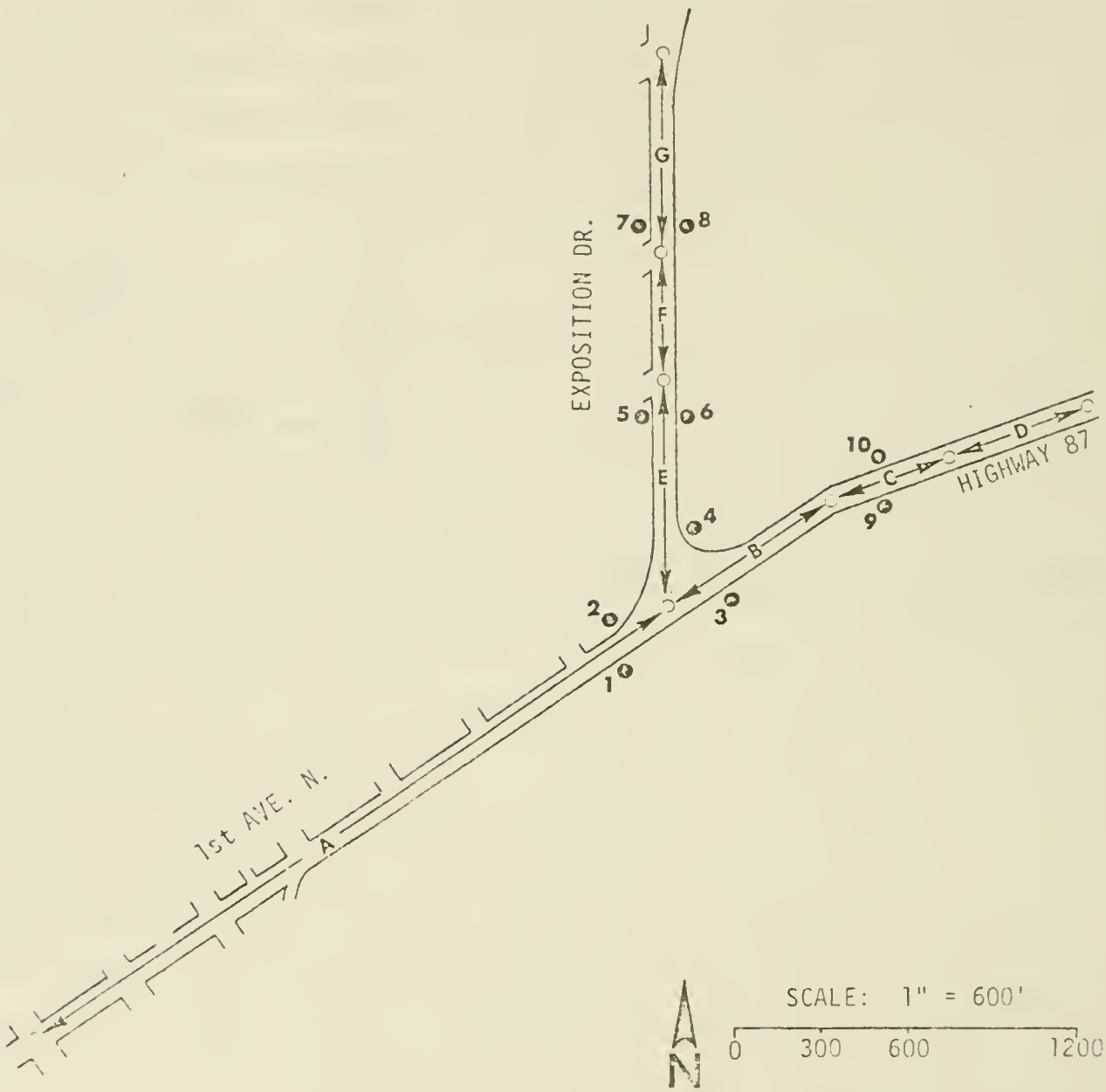


Figure 3. Billings CO analysis area.

Bureau site at 27th and Montana. Siting procedures for these monitors have not yet been concluded, but will be addressed in the 1981 Network Review.

Other Areas

The Bureau wishes to use one or two of its CO monitors to screen potential problem areas in various cities throughout the state. If shelters are available, the first of these SPM monitors will be sited in 1981 at Seventh and Main in Bozeman, and at Idaho and Main in Kalispell. In 1982, the Bureau hopes to site a monitor at the intersection of Lyndale, Montana Avenue, and Helena Avenue in Helena.

Modifications to CO Network

The Bureau recommends the following modifications to its CO network:

1. Establish a "neighborhod" SPM station at Rose Park in Missoula;
2. Locate SPM stations at Thirteenth and Grand and a downtown location in Billings (if funding permits); and
3. Possibly establish an SPM station in downtown Great Falls.

TABLE 13

Traffic Counts

Billings	
Main Street just south of Wicks Lane	25,000*
Main Street just north of STate 318	30,400
Main Street just north of 7th Ave. No.	27,583
Exposition Drive just south of 6th Ave. No.	29,500*
Exposition Drive between 2nd and 3rd Ave. No.	17,000*
1st Ave. No. just west of Exposition Dr.	19,000*
Grand Avenue betwen 1st St. W - Division Street	22,656
State Avenue just west of Orchard Lane	23,640
Grand Avenue betwen 5th & 6th St. West	23,000*
Grand Avenue just east of 17th St. West	20,000*
Grand Avenue just east of 15th St. West	22,000*
Main Street just south of Milton Road	26,000*
24th Street West between Wyoming Ave. & Broadwater	20,000*
Bozeman	
7th & Main	20,500*
Butte	
Amherst & Harrison	19,000*
Front & Utah	18,150
Great Falls	
Central Ave. and Bypass	20,890
10th Ave. So. and 9th Street	30,000*
Helena	
Lyndale, Montana Avenue and Helena Avenue	19,100
Kalispell	
Main Street and Idaho	19,000*
Missoula	
Brooks, South, & Russell (Malfunction Junction)	20,350
Russell & Broadway	21,280
Downtown	18,500*

*estimated

Ozone (O_3)

Ozone in the lower atmosphere generally is formed by reactions of various photochemical substances with hydrocarbons and nitrogen oxides produced by automobiles and some industrial sources, such as refineries. Natural sources of ozone include formation by lightning and transport of stratospheric ozone to lower levels, but concentrations due to these causes typically are very low. Ozone due to man's activities is a secondary pollutant that requires an accumulation of precursor emissions (hydrocarbons and/or nitrogen oxides), warm, sunny weather, and relatively little ozone removal, for high concentrations to develop. Because several hours are required for ozone formation, and because large accumulations or precursor emissions are most likely in air that travels across a precursor emitting region, maximum concentrations of ozone generally are found five to seven hours after rush hour downwind of the emitting region. Warm temperatures facilitate ozone formation, so high concentrations generally are confined to the warmer months.

Because of the mixig that occurs during the formation time of ozone, smaller spatial scales of representativeness are not appropriate for ozone monitorino. Appropriate scales thus include "neighborhood," "urban," and "regional."

Site selection for ozone monitoring initially involves the identification of the monitoring's objective, the site type(s) that will best serve the desired objective, the general site locations, and, finally, the specific monitoring locations. Considerations involved in classifying monitoring objectives and assigning site types include deciding whether the effects of a single large source are to be typified or excluded, considering the time required for atmospheric chemical reactions, and determining the spatial scale to be represented.

The Bureau currently is monitoring ozone in Billings, Butte, and Missoula.

All the Bureau's monitors are located within the cities; for Butte and Missoula, the Bureau considers this adequate, since the low average wind speeds and mountainous terrain in these areas result in little air movement during the time required for ozone formation to take place. East of the mountains, Billings and Great Falls are the only cities large enough to have a potential for high ozone concentrations, and due to the higher average wind speeds in these areas, the highest ozone concentrations are expected to occur from ten to fifty miles downwind of these cities.

Missoula Area

The Bureau now monitors ozone at the Lions' park site, which is to be closed and relocated to Rose Park because of problems meeting siting criteria for TSP and CO at Lions Park. The Bureau plans to discontinue its ozone monitoring at the site because 1) a lack of personnel to operate the monitor, and 2) the site has never measured significant concentrations of ozone.

Butte Area

The Hebgen Park SLAMS station will continue operation. The objective for this station is "population," and it is sited according to the "urban" scale of representativeness.

Great Falls Area

No monitoring for ozone is underway in Great Falls, because, due to the excellent mixing conditions, the area probably does not experience high ozone concentrations. The highest concentrations in the area probably would occur forty or fifty miles downwind, so, if funding permits, the Bureau may establish an ozone SPM station near Fort Benton in 1982.

Billings Area

The Bureau recently has placed the Shawnee Park (SPM) station into operation. The monitoring objective of this station, located near the Hardin interchange about five miles east-northeast of Billings, is "source," and it is sited according to the "urban" scale of representativeness. The station was designed to measure ozone concentrations due to precursor emissions in Billings during periods of light winds. In order to measure concentrations during windier periods, the Bureau may establish an SPM monitor in 1982 between 15 and 40 miles east-northeast of Billings. The station will be sited according to the "regional" scale of representativeness.

Modifications to the Ozone Network

The Bureau recommends the following changes to its ozone network:

1. Discontinue ozone monitoring in Missoula; and

2. Possibly establish new ozone stations near Fort Benton and east-northeast of Billings in 1982.

Nitrogen Dioxide (NO_2)

Nitrogen dioxide is a toxic, corrosive, and highly oxidizing gas formed from the oxidation of nitric oxide (NO), a process that typically requires about two hours reaction time. Since the automobile is the primary source of NO, highest concentrations of nitrogen dioxide generally occur downwind of rush hour traffic areas about two hours after the rush hour.

The Bureau has monitored nitrogen dioxide in Anaconda, Billings, Butte, and Missoula. Highest concentrations measured have occurred in Butte and Missoula, but no observed concentration has been greater than either the federal or Montana standard.

The siting procedures for nitrogen dioxide monitoring are simlar to those for ozone. Maximum concentrations can be expected to occur near the downwind edges of cities, due to the formation time required. Appropriate siting scales are "neighborhood," "urban," and "regional."

Anaconda Area

The Bureau monitored NO_2 at the Lincoln School site in 1978 and 1979 as part of the Montana Air Pollution Study (MAPS). When the data collection phase of MAPS ended in early 1980, NO_2 monitoring in Anaconda was discontinued. The Bureau does not believe any further NO_2 monitoring in Anaconda is warranted.

Missoula Area

The Bureau has been monitoring nitrogen dioxide at the Lions' Park site, which is being relocated to Pose Park. The Bureau plans to discontinue its nitrogen dioxide monitoring in Missoula, because of a shortage of personnel to operate the monitor and because measured concentrations have never exceeded the standards.

Butte Area

The Hebgen Park (SLAMS) monitoring station will continue to be operated. The monitoring objective is "population", and the station is sited according to the "urban" scale of representativenes.

Great Falls Area

Because of the excellent mixing conditions in this area, the Bureau does not plan to monitor nitrogen dioxide in Great Falls.

Billings Area

Nitrogen dioxide will be monitored at the new Fairgrounds site. The monitoring objective at this SLAMS station is "population," and the station is sited according to the "urban" scale of representativeness.

Modifications to NO_2 Network

The modifications to the NO_2 network are:

1. Discontinue NO_2 monitoring in Missoula; and
2. Establish a SLAMS station at the Fairgrounds in Billings.

Lead

Ambient concentrations of lead are determined from analyses of high-volume sampler fil found in Montana, i.e., the Anaconda Company copper smelter in Anaconda and the ASARCO lea Helena area shows concentrations of lead greater than the Montana and federal standards. concentrations at the Hastie and A&W sites in East Helena and at the Lincoln School site i

The Bureau is funding a one-year monitoring study in the East Helena area to begin in network of high-volume, low-volume, membrane, and dihotomous samplers in the vicinity of t study will be used to determine the future monitoring needs in the area.

Fluorides

High ambient concentrations of fluorides have been measured around the Anaconda Aluminum Plant in Columbia Falls and the Stauffer Chemical plant near Ramsey. In the past, the Bureau has measured fluoride concentrations by means of static and vegetative sampling. These efforts will continue around the Columbia Falls and Ramsey areas. The National Park Service will continue its fluoride sampling in Glacier National Park. These samples will be analyzed by the Bureau as in the past.

In light of Montana's new foliar fluoride standard, the Bureau will collect vegetation samples at the sites listed in Table 11. These samples will be collected during the growing season, according to methods prescribed in the Bureau's Quality Assurance Manual.

Rationale for Site Designations

The Bureau's stations are designated either NAMS, SLAMS, or SPM depending on the general purpose of the station and the period of time it is expected to operate. Table 19 lists some of the reasons for which each type of station is operated.

In general, NAMS and SLAMS are intended to operate for long periods of time. Stations established for short-term measurements are normally designated SPM. If it later is decided to maintain the station beyond its originally projected closing date, the station could be redesignated SLAMS.

Table 20 lists the Bureau's SPM stations, their projected closing dates, and the reasons for their operation.

TABLE 14

SUMMARY OF PROPE SITING CPITERIA

Pollutant	Scale	Height above Ground, meters	Distance from Supporting Structure, meters Vert.	Horiz.	Other Spacing Criteria
TSP	All	2-15	--	2	1. Should be 20 meters from trees 2. Distance from sampler to obstacle must be at least twice the height the obstacle protrudes above the sampler. 3. Must have unrestricted airflow 270° around the sampler. 4. No furnace or incineration flues should be nearby. 5. Must have minimum spacing from roads. This varies with height of moitor and spatial scale.
SO_2	All	3-15	1	1	1. Should be 20 meters from trees. 2. Distance from inlet probe to obstacle must be at least twice the height the obstacle protrudes above the inlet probe. 3. Must have unrestricted airflow 270° around the inlet proble, or 180° if probe is on the side of a building. 4. No furnace or incineration flues should be nearby.
CO	Micro	3 1/2	1	1	1. Must be 10 meters from intersection and should be at a midblock location. 2. Must be 2-10 meters from edge of nearest traffic lane. 3. Must have unrestricted airflow 180° around the inlet probe.

CO	Middle Neighborhood	3-15	1	1	1. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 2. Spacing from roads varies with traffic.
O_3	All	3-15	1	1	1. Should be 20 meters from trees. 2. Distance from inlet probe to obstacle must be at least twice the height the obstacle protrudes above the inlet probe. 3. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 4. Spacing from roads varies with traffic.
NO_2	All	3-15	1	1	1. Should be 20 meters from trees. 2. Distance from inlet probe to obstacle must be at least twice the height the obstacle protrudes above the inlet probe. 3. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 4. Spacing from roads varies with traffic.

TABLE 15

SAMPLING AND ANALYSIS METHODS

Parameter	Method
TSP - all sites	High Volume Method 40 CFR, Part 50, Appendix B
SO_2 - all sites	EQSA-0276-009 "Thermo Electron Model 43 Pulsed Fluorescent SO_2 Analyzer"
CO - all sites	REFA-0276-008 "Bendix Model 8501-5CA Infrared CO Analyzer"
O_3 - all sites	EQOA-0577-019 "Dasibi Model 1003-AH, 1003-PC, or 1003-RS Ozone Analyzers"
NO_2 - all site	REFA-0479-038 "Bendix Model 8101 B Oxides of Nitrogen Analyzer" REFA-0677-021 "Monitor Labs Model 8440E Nitrogen Oxides Analyzer"

TABLE 16

STATE OF MONTANA, AIR QUALITY BUREAU

AIR MONITORING NETWORK

Station		Saroad Site I.D.	Monitoring Objectives	Spatial Scale	Target Date New station to open	Target Date Existing station to close
I. Total Suspended Particulates (TSP)						
		National Air Monitoring Stations (NAMS)				
Billings	Taft School	27 0080 062 F01	H,P.S,	N		
	Taft School(co-located)	27 0080 062 F07	P,S,	N		
Great Falls	Downtown	27 0660 017 C01	H,P	N		
	Downtown (co-located)	27 0660 017 C07	H,P	N		
		State and Local Air Monitoring stations (SLAMS)				
Anaconda	Highway Junction	27 0400 004 F02	S	N		
	Lincoln School	27 0020 007 F01	P,S	N		
	Mill Creek	27 0400 040 F02	S	N	1/81	
Billings	Bench School	27 0080 028 C02	P	N		
	City Hall	27 0080 008 F01	H,P	N		
	Grand Avenue School	27 0080 009 C01	P	N		
	Lockwood School	27 0080 006 F05	P	N	11/80	
Bozeman	East Main City Building	27 0120 002 F01	P	N		
Butte	Greeley School	27 0160 005 F01	H,P,S	N		
	Greeley School (co-located)	27 0160 005 F07	H,P,S	N		
	Hebgen Park	27 0160 018 F01	P,S	N		
Colstrip	BN	27 1360 027 F02	S	N		9/80
	Downtown	27 1360 033 F02	S	N	12/80	
Columbia Falls	Anders Residence	27 0270 005 F01	P,S,	N		

	Dehlbohm Trailer (NAAC)	27 0480 029 F02	S	N	
Decker	Thomas Ranch (Morton)	27 0060 009 F03	S	N	
East Helena	Hastie Residence	27 0860 002 F02	P,S	N	
	A & W	27 0860 008b F02	H,P,S	N	
	A & W (co-located)	27 0860 008 F07	H,P,S	N	11/80
Great Falls	Black Eagle P.O.	27 0660 019 G01	H,P,S	N	
	Lincoln School	27 0660 020 G01	P	N	
Hardin	Absalooka Mine	27 0060 033 F02	S	N	10/80
Havre	Central Havre City Bldg.	27 0700 001 F01	P	N	
Helena	Cogswell Buildig	27 0720 001 F01	P	N	
Kalispell	Universal Athletic	27 0800 015 F01	P	N	
Laurel	Farm Site	27 0840 009 F01	S	N	11/80
Libby	Brown Residence	27 0900 010F01	P,S	N	
Lindsay	Wielgosh REsidence	27 0360 004 F03	R	P	
Missoula	Courthouse Roof	27 1100 001 G01	P	N	
	Courthouse Roof (co-loc.)	27 1100 001 C07	P	N	
	McLeod Park	27 1100 021 F01	P	N	
	Rose Park	27 1100 020 G01	P	N	9/80
Ovando	Terry Smith Panch	27 1260 024 F03	R	P	
Ramsey	Tierney Residence	27 1480 015 F02	S	N	

Special Purpose Monitors (SPM)

Anaconda	Warm Springs	27 0400 039 F02	S	N	

Big Fork	Stine Residence	27 0480 036 F05	P	N		
Bozeman	MSU Family Housing	27 0120 003 F01	P	N		
	Traphagen Hall	27 0120 001 F01	P	N		
Butte	Dr. Canty's Office	27 0160 019 F01	P	N		
	Floral Park	27 0160 020 F01	P	N		8/80
	Walkerville Blaine Sch.	27 0160 029 F01	P,S	N		8/80
						8/80
Colstrip	Peabody Coal	27 1360 034 F02	S	N	3/81	
Glacier National Park	St. Mary	27 0570 010 F02	P	P		
	West Glacier	27 0570 007 F02	P	P		
Glendive	Dawson Comm. College		P	N	8/80	
Great Falls	Kivanis Park	27 0660 016 F01	P	N		
	Riverview School	27 0660 018 G02	S	N		
Helena	Valley Bank	27 0720 012 G05	P	N		
	Capital Courts	27 0720 013 G05	P	N		
	Valley		P	N	4/81	
Kalispell	Evergreen	27 0800 016 F01	P	N		
	Airport	27 0480 304 F05	P	N		
	Moose City		P	P		
Laurel	Junior High	27 0840 001 G01	S,P	N		
Lewistown	Central Lewistown	27 880 002 F01	P	N		
Miles City	PCA Building	27 1040 003 F01	P	N		
Missoula	Lions Park	27 1100 019 F01	P	N		
	Hoerner-Waldorf II	27 1100 016 G02	S	N		9/80
Polebridge	Flathead Project	27 0480 035 F05	P	N		
Polson	Lake Co. (Trussler)	27 0820 010 F05	P	N		
Ronan	Lake Co. (Hakaluk)	27 0820 011 F05	P	N		
Thompson Falls	Thommpson Falls		P	N	12/80	

Scobey	Border Station	27 0340 001 F03	S,P	P			
	Richardson	27 0340 002 F03	P	P			
	Engberg	27 0340 003 F03	P	P		7/80	7/80
	Hanrahan	27 0340 004 F03	P	P	8/80		

II. Sulfur Dioxide (SO_2)

National Air Monitoring Stations (NAMS)

Billings	Taft School	27 080 062 F01	S, H	N			

State and Local Air Monitoring stations (SLAMS)

Anaconda	Lincoln School	27 0020 007 F01	S	N			
East Helena	A &W	27 0860 008 F02	S	N			
Laurel	Farm Site	27 0840 009 C05	S,H	N			

Special Purpose Monitors (SPM)

Billings	Coburn Road		S	N	3/81		
	Fairgrounds	27 080 061 F02	S,P	N	3/81		
	North Johnson Lane		S	N	3/81		
	Piccolo Road		S	N	3/81		
	Lockwood School	27 0080 006 F05	S	N	3/81		
Laurel	Boxcar		S	N	3/81		
Scobey	Border Station	27 0340 001 F03	S	P			
	Hanrahan	27 0340 004 F03	S	P	7/80		

III. Carbon Monoxide (CO)

		State and local Air Monitoring stations (SLAMS)			
Billings	Fairgrounds	27 0080 061 F02	P,H	M	8/80
Great Falls	Great Falls Federal	27 0660 021 C02	H,P,S	M	
Missoula	Malfunction Junction	27 1080 003 F01	H,P	M	
		Special Purpose Monitors (SPM)			
Billings	Thirteenth and Grand		P,S	M	6/81
	Downtown		P,S	Mi	6/81
Bozeman	Seventh and Main		P,S	M	7/81
Great Falls	Downtown		P,S	M	9/83
Kalispell	Idaho and Main		P	M	8/81
Missoula	Downtown	27 1100 023 C02	H,P	M	
	Rose Park	27 1100 020 C01	P	M	9/80
Helena	Lyndale, Montana & Helena Avenue		H,P	M	9/82

IV. Ozone (O_3)

		State and Local Air Monitoring Stations (SLAMS)			
Butte	Hebgen Park	27 0160 017 F01	P	U	
Missoula	Rose Park	27 1100 020 F01	P	M	9/80
		Special Purpose Monitors (SPM)			
Billings	Shawnee Park		S	U	9/80

Custer			S	P	5/82		
Fort Benton			S	P	5/82		

V. Nitrogen Dioxide (NO_2)

State and Local Air Monitoring Stations (SLAMS)

Billings	Fairgrounds	27 0080 061 F02	H	U	9/80		
Butte	Hebgen Park	27 0160 017 F0L	P	N			
Missoula	Rose Park	27 1100 020 F01	P	N		10/80	9/80

Monitoring Objectives:

- H Highest Concentration
- P Population
- S source
- B Background

Spatial Scales:

- Mi Micro
- M Middle
- N Neighborhood
- U Urban
- R Regional

TABLE 17

MONTANA AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Polltant	Montana standard	Federal Primary Standard	Federal Secondary Standard
Total Suspended Particulates	75 ug/m^3 annual average 200 ug/m^3 24-hr average*	75 ug/m^3 annual geometric mean 260 ug/m^3 24-hr average*	60 ug/m^3 annual geometric mean 150 ug/m^3 24-hr average*
Sulfur Dioxide	0.02 ppm annual aveage 0.10 ppm 24-hr average* 0.50 ppm 1-hour average**	0.03 ppm annual average 0.14 ppm 24-hr average*	0.5 ppm 3-hr average*
Carbon Monoxide	9 ppm 8-hr average* 23 ppm hourly average*	9 ppm 8-hr average* 35 ppm 1-hr average*	9 ppm 8-hr average*
Nitrogen Dioxide	0.05 ppm annual average 0.30 ppm 1-hr average*	0.05 ppm annual average	0.05 ppm annual average
Photochemical Oxidants (ozone)	0.10 hourly average*	0.12 ppm 1- hr average*	0.12 ppm 1-hr average*
Lead	1.5 ug/m^3 90-day average	1.5 ug/m^3 calendar quarter average	0.12 ppml-hr average*
Foliar Fluoride	20 ug/g monthly average	None	None
Hydrogen Sulfide	0.05 ppm hourly average*	None	None
Settled Particulate (Dustfall)	10 gm/m^2 30-day average	None	None
Visibility	Particle scattering co-efficient of 3 x 10^{-5} per meter annual average	None	None

*Not to be exceeded more than once per year
ug/m^3 micrograms polutant per cubic meter of sampled air
ppm parts pollutant per milion parts of sampled air

**Not to be exceeded more than 18 times per year.

TABLE 18

RELATIONSHIP BETWEEN SITING OBJECTIVES AND DATA USES

General Monitoring -Objectives	Specific Monitoring Objectives	Data Uses
A. Highest Concentration	1. Determination of Peak Concentrations in urban and Nunurban areas	Judging attainment/maintenace of NAAQS Evaluating progress in achieving/maintaining of NAAQS Developing/revising SIPS/evaluating control strategies. Supporting enforcement action. Public Information.
	2. Emergency Episode Abatement Initiation and Monitoring.	Documenting episodes and initiating episode controls. Public information.
B. Population	1. Determination of Population Exposure in Populated Areas	Documenting population exposure and health research. Public Information.
C. Source Imapct	1. Determination of the impact of isolated point sources	Developing/revising SIPs/evaluating strategies. Reviewing new sources. Supporting enforcement actions.
	2. Determination of the Impact of Individual Point Source in Multi-Source Urban Setting.	Developing/revising SIPs/evaluating control strategies. Reviewing new sources Supporting enforcement actions.
D. General Background	1. Determination of Base Concentration in Areas of Projected Growth.	Establishing baseline air quality levels for PSD planning and AQMP. Evaluating progress in achieving/maintaining NAAQS.

	Developing/revising SIPs to attain/maintain NAAQS. Public Information
2. Assessment of Background Concentration in Rural Areas.	Establishing baseline air quality levels for PSD planning and AQMP. Developing/revising SIPs to attain/maintain NAAQS Public Information
3. Diffusion Model Calibration and Refinement.	Estimation of air quality levels.

TABLE 19

MAJOR STATION DESCRIPTIONS AND COMPARISONS

Monitoring Station	SLAMS	NAMS	SPM
Purpose	General program monitoring for criteria pollutants. Supplies data for state implementation plan (SIP). Used for emergency episode monitoring.	Sets national policy, obtains long-term trend data, is used in special national studies, and is selected to monitor highest pollution areas which also have high population.	Special and short-term monitoring according to Montana needs. Monitors non-criteria pollutants.
Installation Deadline	January 1, 1983	January 1,1981	None
Review Frequency	Annual	Each third year	Annual
Relocation Frequency	Relocated or changed only on annual basis if necessary and with EPA approval.	Not to be moved	No restrictions
Data Reporting	Beginning in 1981, annual reports due by July 1st of the following year to EPA Region and headquaters in N. Carolina.	Same	No reports due unless data is used for SIP purposes.
Rreport Requirements	Detailed summary, including violations of standards.	Same	None

TABLE 20

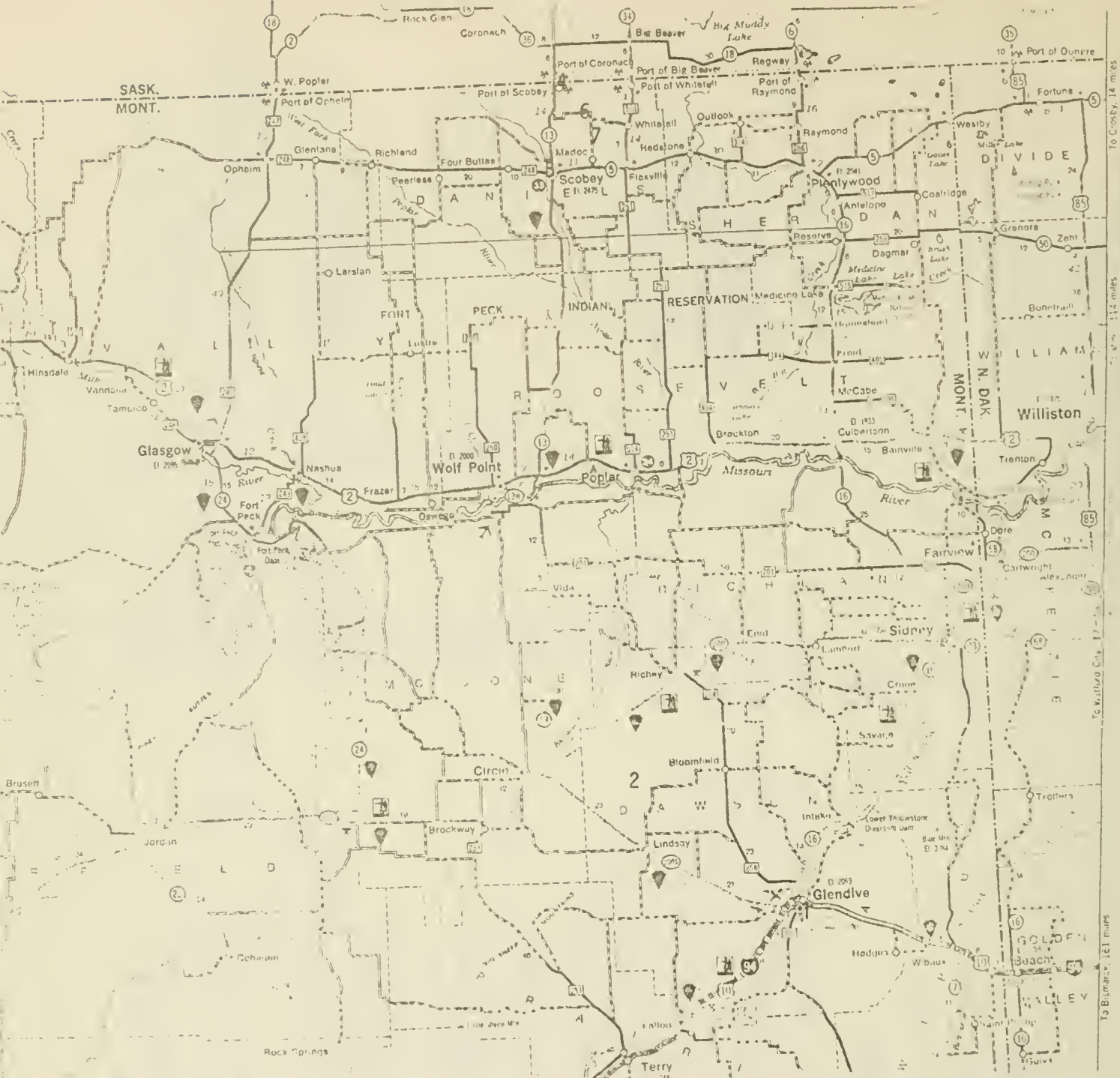
STATE OF MONTANA, AIR QUALITY BUREAU

SPECIAL PURPOSE MONITORS

Project or Study	Station	Projected Closing Date	Pollutant	Remarks
Flathead Environmental Study	Big Fork Stine Residence	6/83	TSP	These stations are part of the Flathead Environmental Study, which is being conducted to analyze the possible environmental effects of resource development in the Flathead River Basin.
	Kalispell Evergreen Airport	6/83	TSP	
	Moose City	6/83	TSP	
	Polebridge Flathead Project	6/83	TSP	
	Polson	6/83	TSP	
	Ronan	6/83	TSP	
	Ninepipes	6/83	TSP	
Poplar River Study	Scobey Border Station	6/83	TSP, SO_2	The Scobey stations to determine the effects of the Coronach power plant in Saskatchwan.
	Richardson	6/83	TSP	
	Hanrahan	6/83	TSP, SO_2	
Anaconda	Warm Springs	10/81	TSP	Station to collect data in previously unmonitored area.
Bozeman	MSU Family Housing	10/81	TSP	Station operated by MSU for research purposes.
	Traphagen Hall	10/81	TSP	

Butte	Dr. Canty's Office	10/81	TSP	Station to collect data in previously unmonitored areas.
	Walkerville Blaine School	10/81	TSP	
Colstrip	Peabody Coal	10/82	TSP	Source station to measure effects of coal mine.
Glendive	Dawson Community College	10/81	TSP	Station to collect data in previously unmonitored areas.
Great Falls	Kiwanis Park	10/81	TSP	
	Riverview School	10/81	TSP	
Helena	Valley Bank	4/81	TSP	"
	Capitol Courts	4/81	TSP	"
	Valley	4/82	TSP	"
Laurel	Junior High	10/81	TSP	"
Lewistown	Central Lewistown	10/81	TSP	"
Miles City	PCA Building	10/81	TSP	"
Missoula	Hoerner-Waldorf II	10/81	TSP	Source station to measure effects of Champion Int. Plant.
Thompson Falls		4/82	TSP	Station to collect data in previously unmonitored areas.

Billings	Thirteenth & Grand	6/82	CO	Station to collect data
	Downtown	6/82	CO	in previously unmonitored areas.
Bozeman	Seventh & Main	7/82	CO	"
Kalispell	Idaho & Main	8/82	CO	"
Missoula	Downtown	6/82	CO	"
	Rose Park	6/82	CO	"
Helena	Lyndale, Montana & Helena Ave.	9/83	CO	"
Billings	Shawnee Park	9/81	O_3	Station to monitor concentrations
Custer		9/82	O_3	downwind of Billings.
Fort Benton		9/83	O_3	downwind of Great Falls


SASK.
MONT.
Glasgow
Wolf Point
Poplar
Scobey
Williston
Sidney
Glendive
Miles City
Terry
Circle
Brockway
Lindsay
Bloomfield
Richey
Fairview
Plentywood
Culbertson
Brockton
Fort Peck
Fort Peck Dam
Missouri River
Yellowstone River
Fort Peck Indian Reservation
Medicine Lake
Big Muddy Lake
Rock Springs
Angela
Forsyth
Hysham
Sanders
Rosebud
Custer
Locate
Kinsey
Horton
Shelfield
Hathaway
Vida
Nashua
Frazer
Oswego
Larslan
Richland
Glentana
Opheim
W. Poplar
Port of Opheim
Port of Scobey
Port of Coronach
Port of Big Beaver
Port of Whitetail
Port of Raymond
Port of Outpre
Rock Glen
Coronach
Big Beaver
Regway
Whitetail
Outlook
Raymond
Westby
Fortune
Four Buttes
Pearless
Madoc
Flaxville
Hedstone
Antelope
Coalridge
Reserve
Dagmar
Grenore
Zahl
Bonetrail
Medicine Lake
Print
McCabe
Bainville
Trenton
Dore
Cartwright
Alexander
Crane
Savage
Lambert
Enid
Vandalia
Tampico
Hinsdale
Brusett
Jordan
Intake
Lower Yellowstone Diversion Dam
Trotters
Hodges
Wibaux
Beach
Golva
Baker
Ismay
Ekalaka
Volborg
Garfield
Carter
Powder River
Custer
Rosebud
Big Horn
Yellowstone
Prairie
Wibaux
Dawson
Richland
Roosevelt
Valley
Daniels
Sheridan
McCone
Fallon
Carter
Golden Valley
Billings
Stillwater
Sweet Grass
Park
Gallatin
Madison
Beaverhead
Big Hole
Jefferson
Broadwater
Lewis & Clark
Powell
Deer Lodge
Granite
Missoula
Ravalli
Lake
Sanders
Flathead
Lincoln
Mineral
Glacier
Toole
Pondera
Teton
Chouteau
Hill
Blaine
Phillips
Valley
Daniels
Sheridan
Roosevelt
McCone
Garfield
Petroleum
Fergus
Judith Basin
Wheatland
Golden Valley
Musselshell
Yellowstone
Carbon

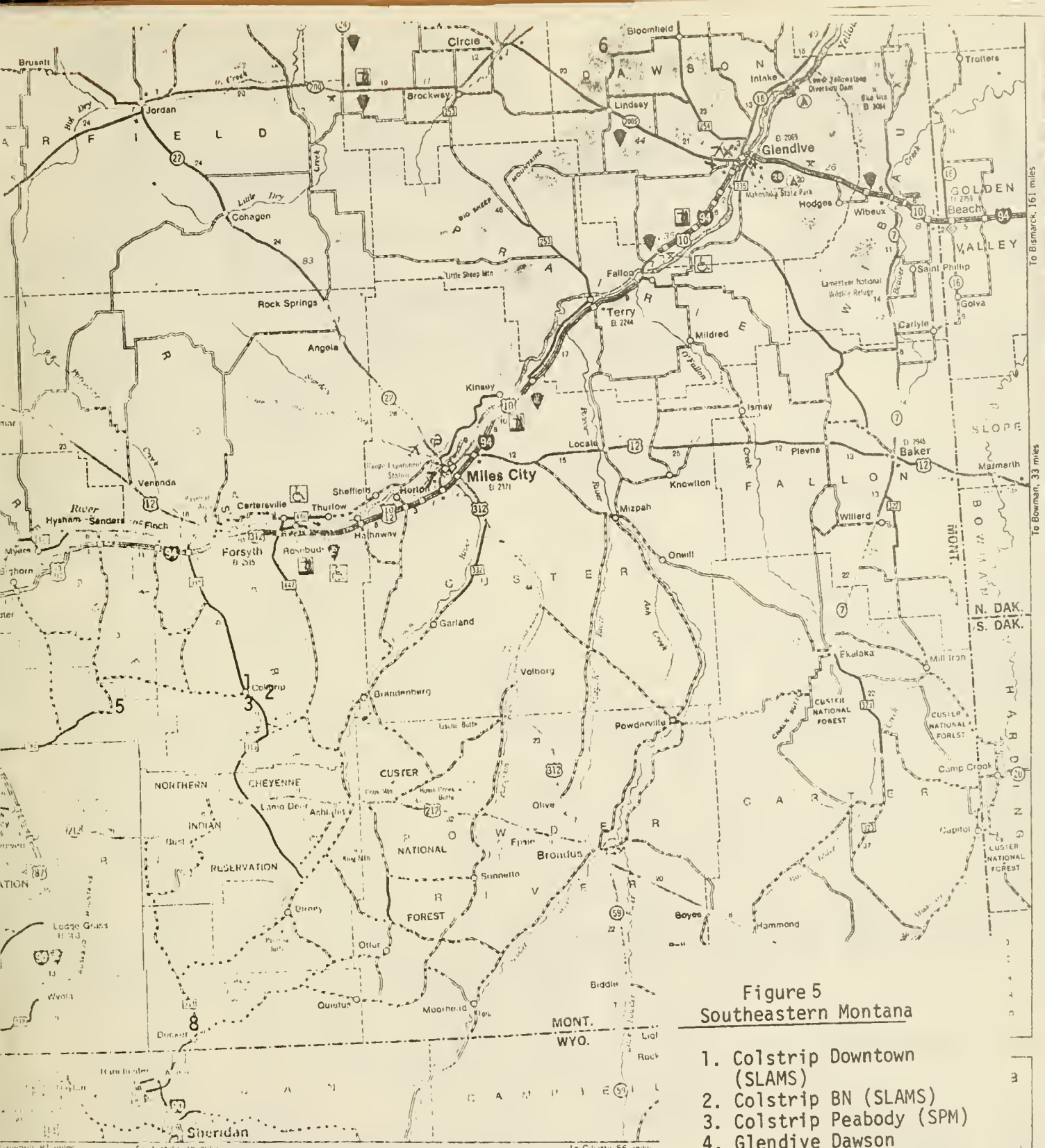


Figure 5
Southeastern Montana

1. Colstrip Downtown (SLAMS)
2. Colstrip BN (SLAMS)
3. Colstrip Peabody (SPM)
4. Glendive Dawson Community College (SPM)
5. Hardin Absaloka Mine (SLAMS)
6. Lindsay Wielgosh (SLAMS)
7. Miles City PCA Bldg. (SPM)
8. Decker Thomas Ranch (Morton)(SLAMS)

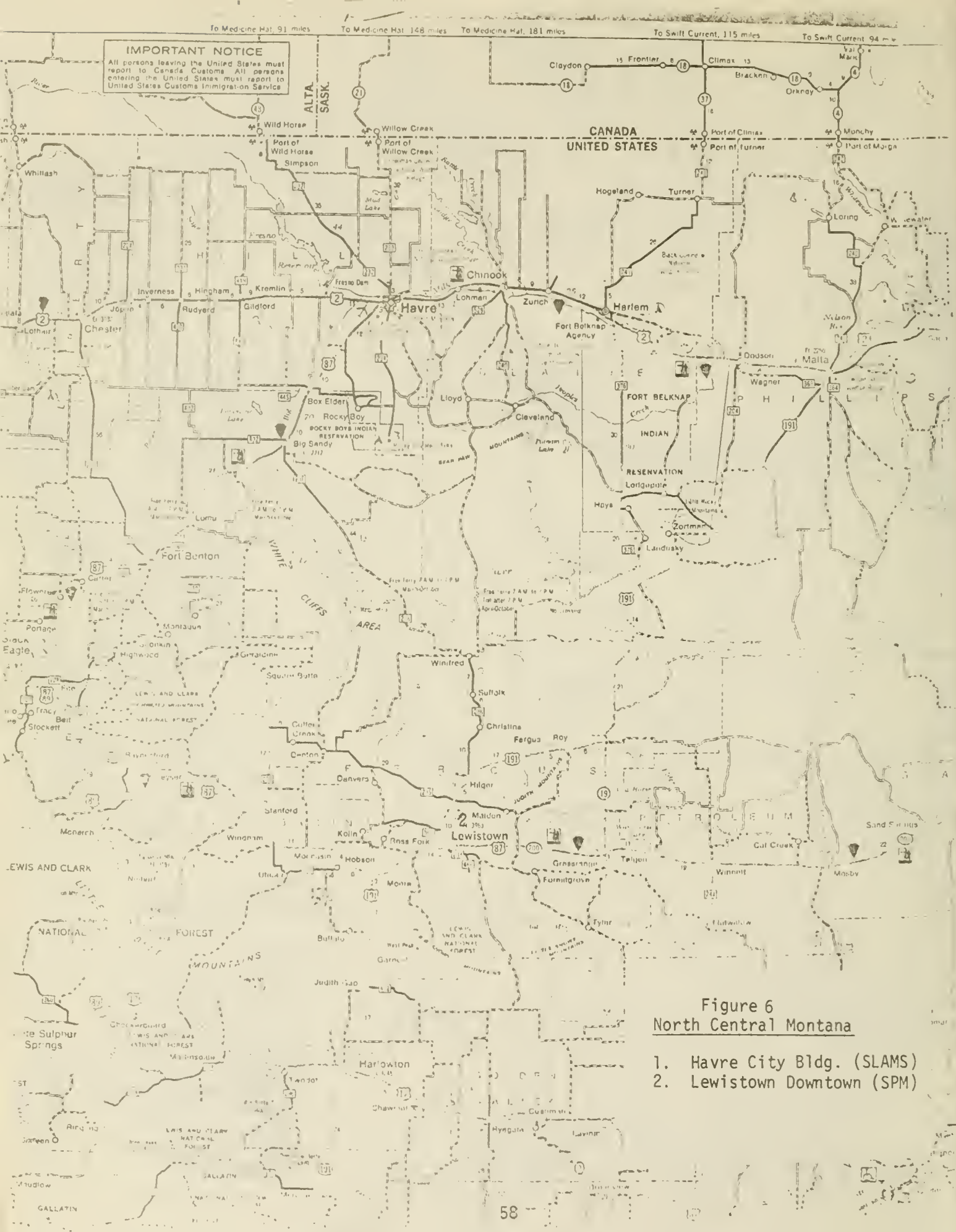


Figure 6
North Central Montana

1. Havre City Bldg. (SLAMS)
2. Lewistown Downtown (SPM)

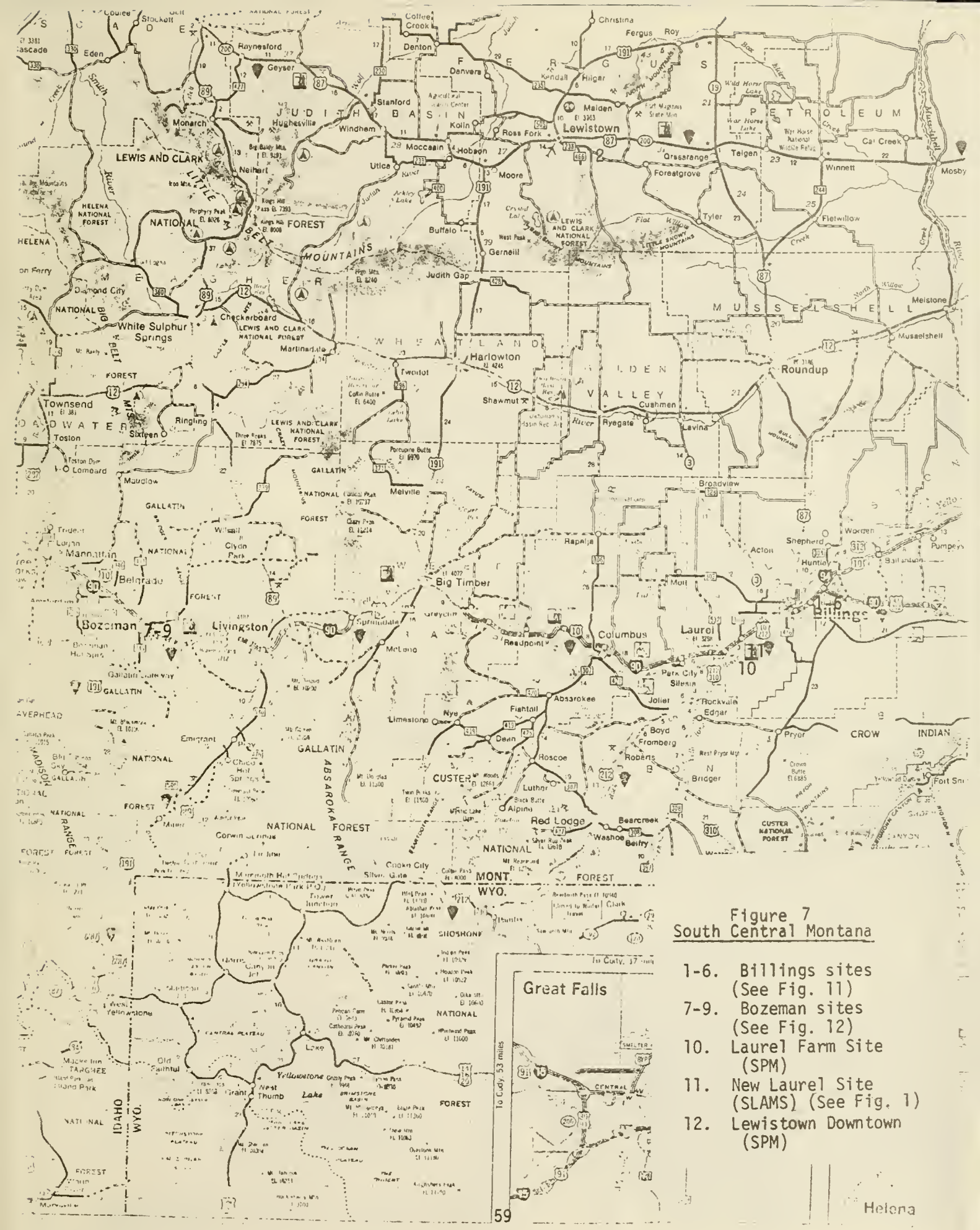


Figure 7
South Central Montana

1-6. Billings sites (See Fig. 11)
7-9. Bozeman sites (See Fig. 12)
10. Laurel Farm Site (SPM)
11. New Laurel Site (SLAMS) (See Fig. 1)
12. Lewistown Downtown (SPM)

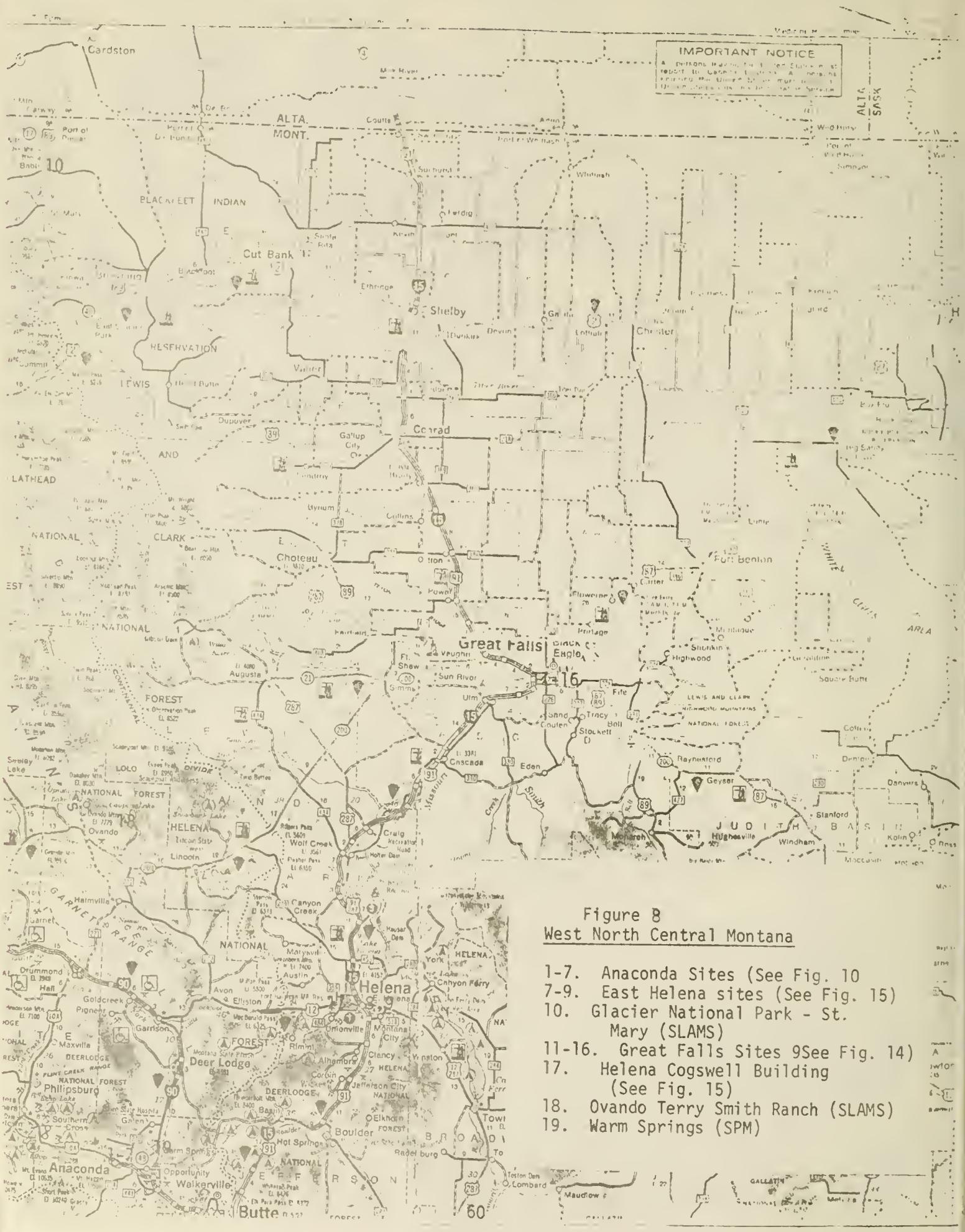
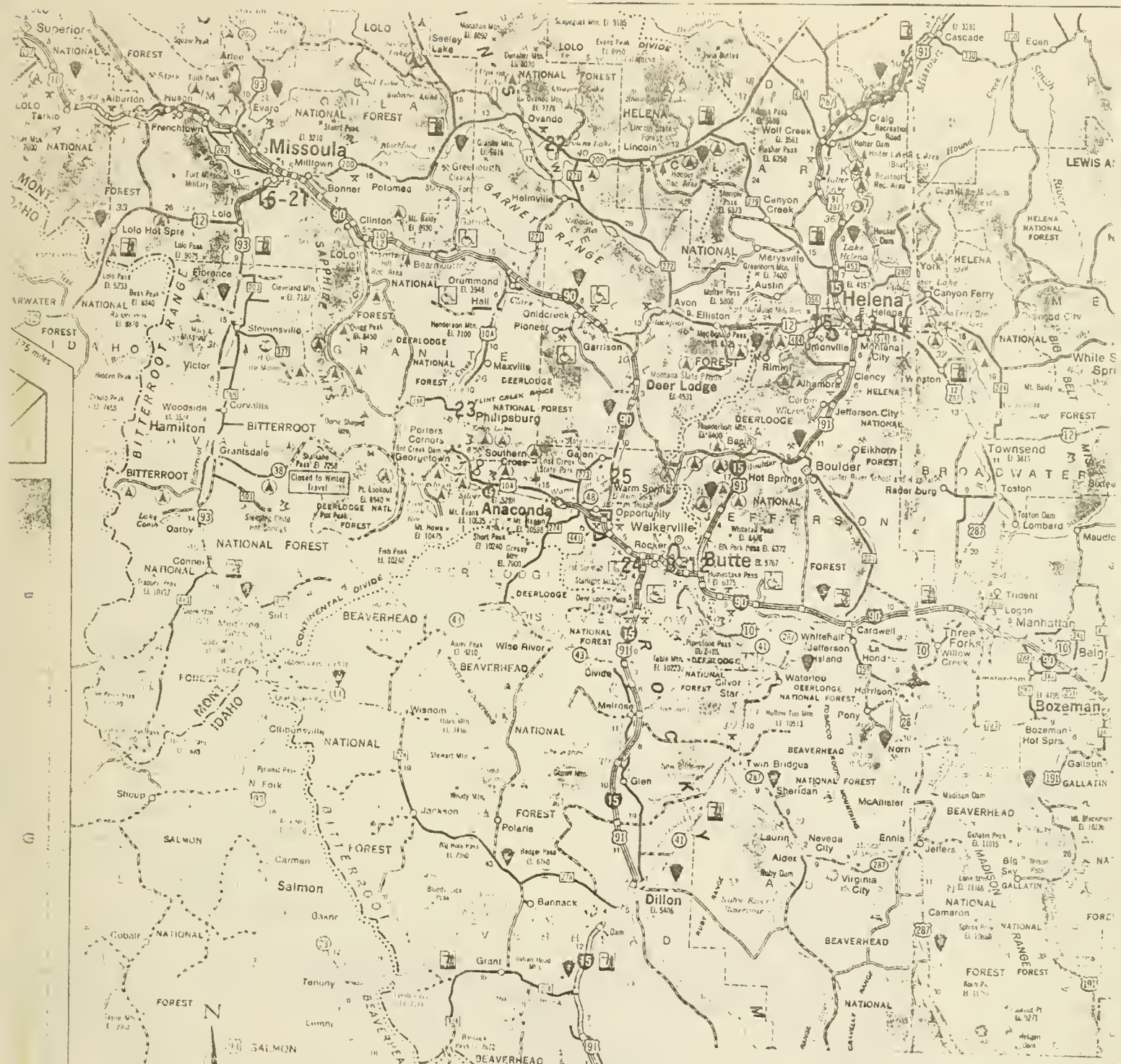


Figure 8
West North Central Montana

1-7. Anaconda Sites (See Fig. 10
7-9. East Helena sites (See Fig. 15)
10. Glacier National Park - St. Mary (SLAMS)
11-16. Great Falls Sites 9See Fig. 14)
17. Helena Cogswell Building (See Fig. 15)
18. Ovando Terry Smith Ranch (SLAMS)
19. Warm Springs (SPM)


Missoula
Anaconda
Butte
Helena
Deer Lodge
Philipsburg
Hamilton
Dillon
Bozeman
Townsend
Boulder
Walkerville
Opportunity
Warm Springs
Drummond
Garrison
Stevensville
Florence
Lolo Hot Spre
Frenchtown
Alberton
Superior
Seeley Lake
Ovando
Lincoln
Craig
Wolf Creek
Canyon Creek
Marysville
Austin
Elliston
Avon
Rimini
Jefferson City
Cardwell
Whitehall
Three Forks
Manhattan
Logan
Trident
Toston
Townsend
Radersburg
Basin
Jefferson Island
Waterloo
Harrison
Pony
Norris
Twin Bridges
Sheridan
Ennis
Virginia City
Nevada City
Alder
Laurin
Melrose
Divide
Wise River
Wisdom
Jackson
Polaris
Bannack
Grant
Glen
Salmon
Challis
Cobalt
Shoup
Clibourn
Conner
Darby
Grantsdale
Woodside
Corvallis
Victor
Porters Corner
Southern Cross
Galen
Georgetown
Maxville
Pioneer
Onidcreek
Helmville
Clinton
Bonner
Potomac
Greenough
Arlee
Evaro
Huson
Milltown
Lolo
Tarkio
Yaak
Eureka
Rexford
Troy
Libby
Whitefish
Kalispell
Columbia Falls
Hungry Horse
Polson
Ronan
Plains
Thompson Falls
Noxon
Trout Creek
Superior
Missoula
Bitterroot Range
Garnet Range
Sapphire Mts
Flint Creek Range
Pioneer Mts
Big Belt Mts
Tobacco Root Mts
Madison Range
Gravelly Range
Ruby Range
Centennial Mts
Lemhi Range
Beaverhead Mts
Lemhi Mts
Salmon River Mts
Clearwater Mts
Bitterroot Mts
Continental Divide
Lewis A
Helena National Forest
Big Belt
Big Sky
Gallatin
Madison
Beaverhead
Deerlodge
Jefferson
Broadwater
Lewis and Clark
Flathead
Lake
Sanders
Mineral
Missoula
Ravalli
Granite
Powell
Lincoln
Flathead
Glacier

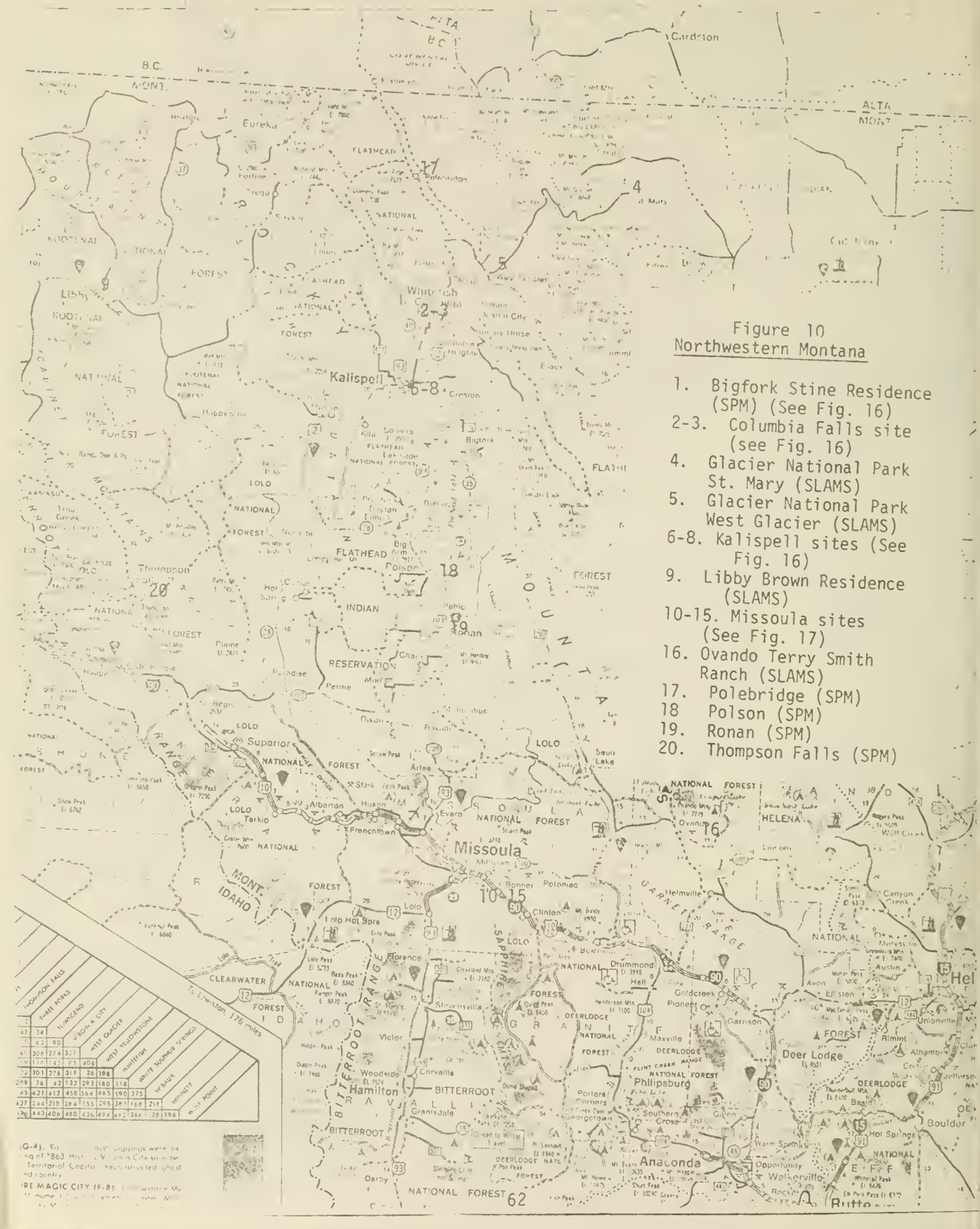


Figure 10
Northwestern Montana

1. Bigfork Stine Residence (SPM) (See Fig. 16)
2-3. Columbia Falls site (see Fig. 16)
4. Glacier National Park St. Mary (SLAMS)
5. Glacier National Park West Glacier (SLAMS)
6-8. Kalispell sites (See Fig. 16)
9. Libby Brown Residence (SLAMS)
10-15. Missoula sites (See Fig. 17)
16. Ovando Terry Smith Ranch (SLAMS)
17. Polebridge (SPM)
18 Polson (SPM)
19. Ronan (SPM)
20. Thompson Falls (SPM)

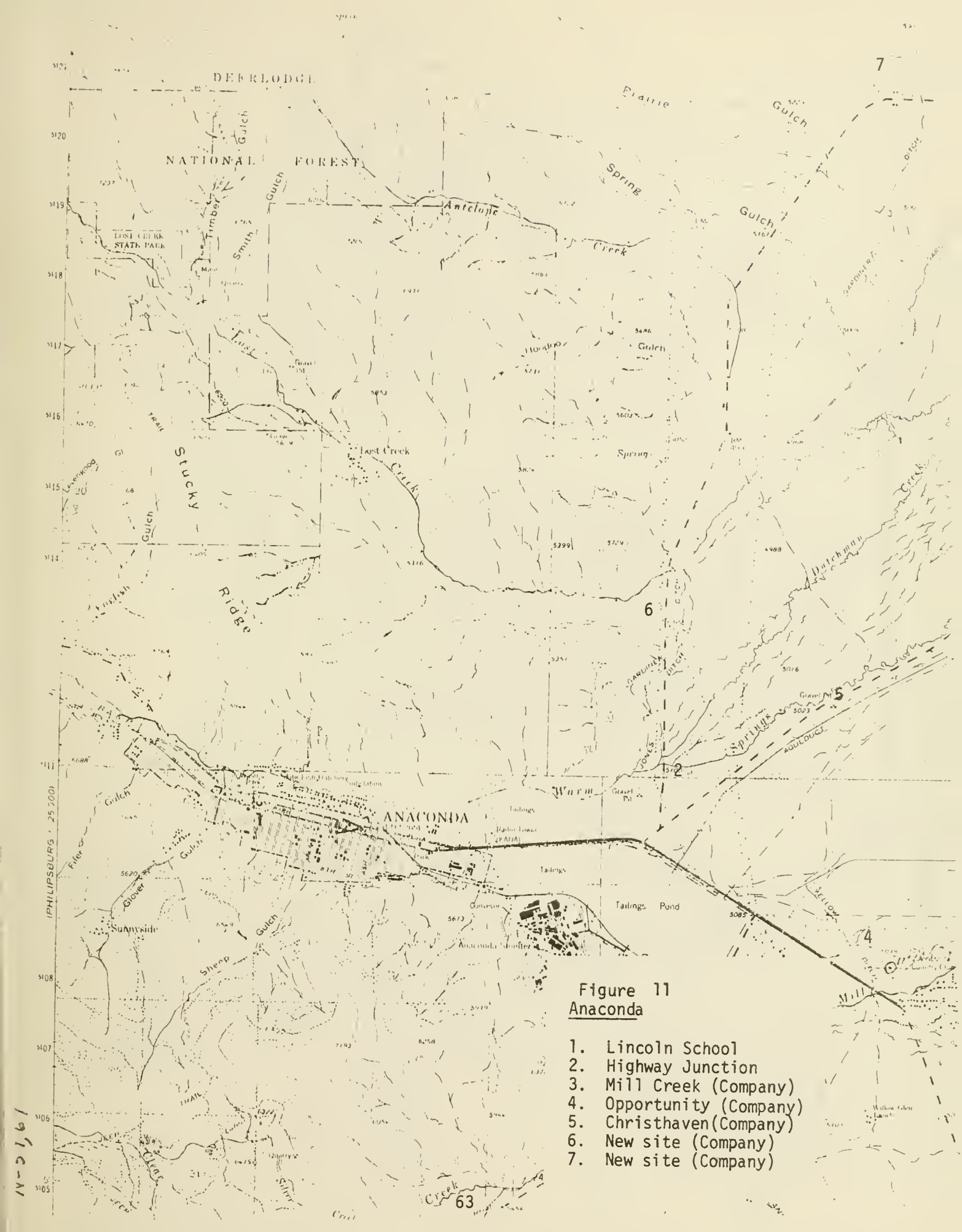


Figure 11
Anaconda

1. Lincoln School
2. Highway Junction
3. Mill Creek (Company)
4. Opportunity (Company)
5. Christhaven (Company)
6. New site (Company)
7. New site (Company)

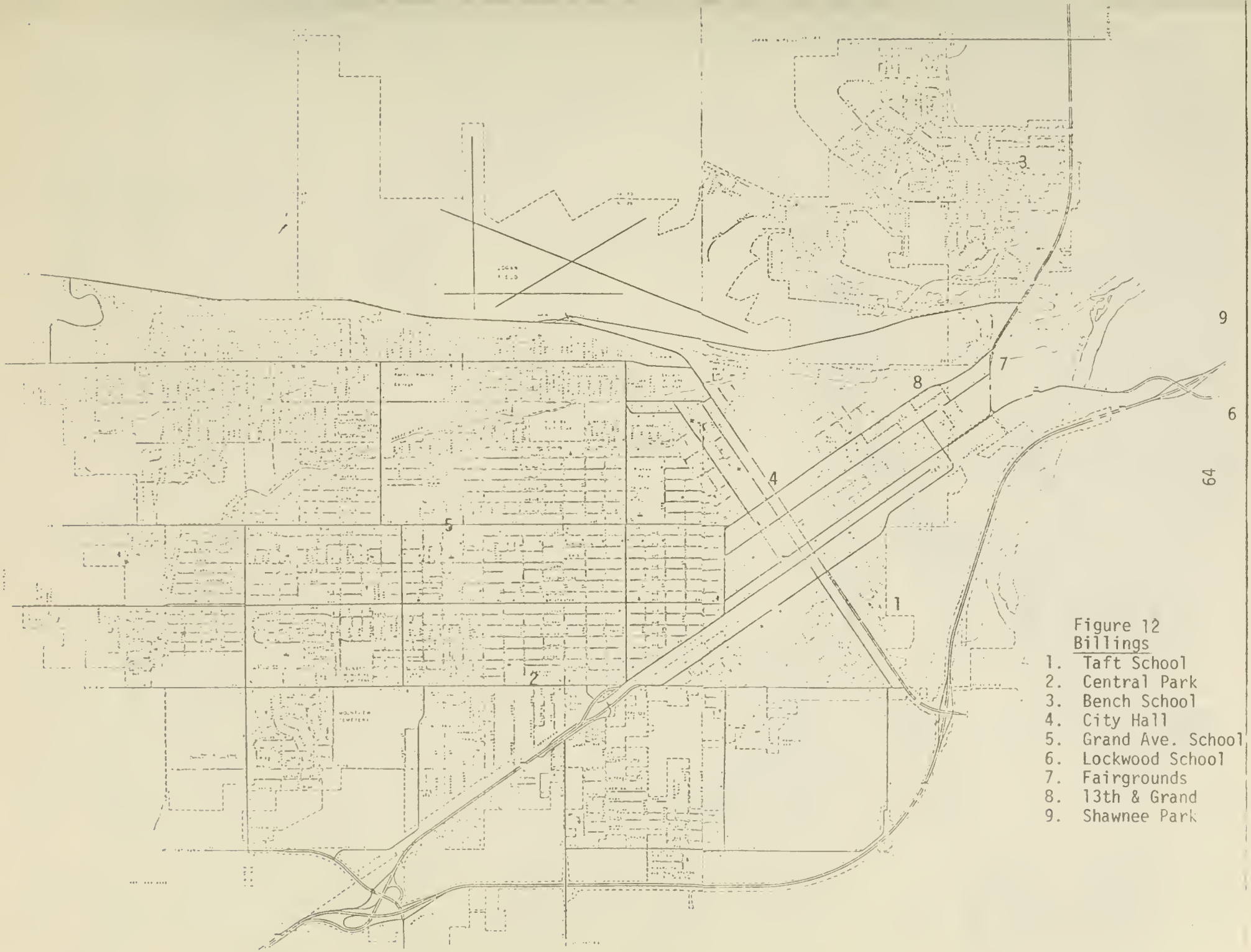


Figure 12
Billings

1. Taft School
2. Central Park
3. Bench School
4. City Hall
5. Grand Ave. School
6. Lockwood School
7. Fairgrounds
8. 13th & Grand
9. Shawnee Park

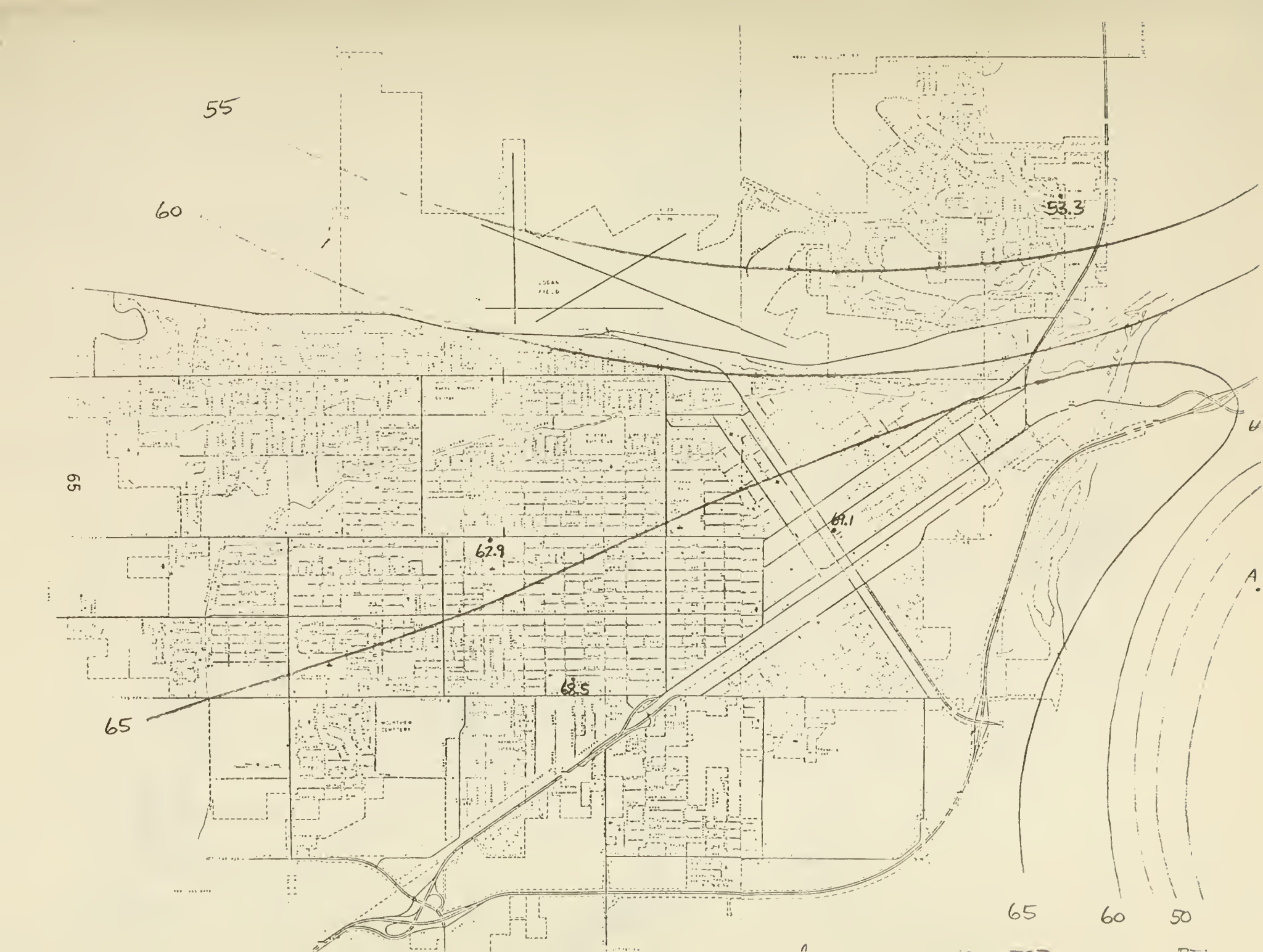
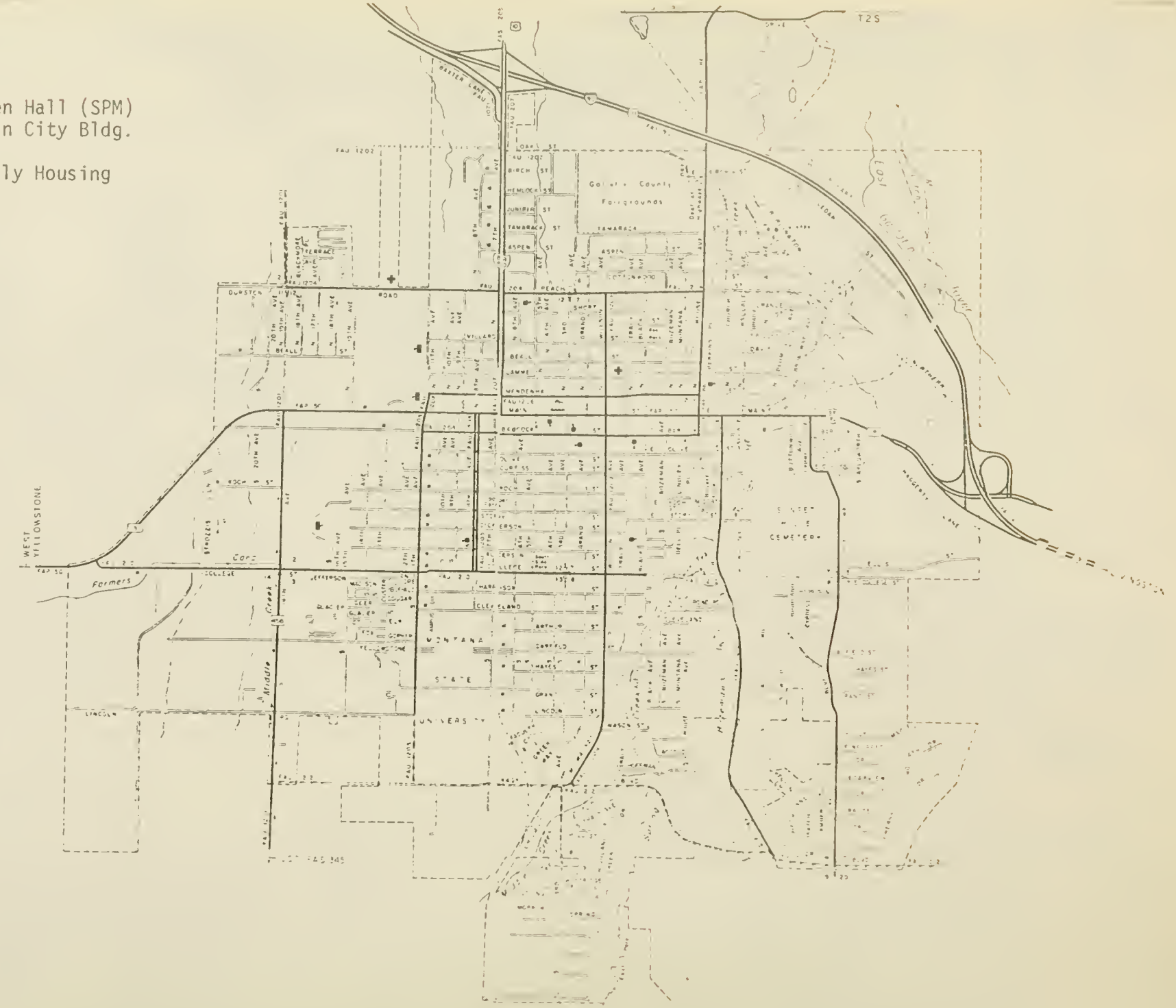

55
60
53.3
65
69.1
62.9
68.5
65
65
60
50

Figure 13
Bozeman

1. Traphagen Hall (SPM)
2. East Main City Bldg. (SLAMS)
3. MSU Family Housing (SPM)



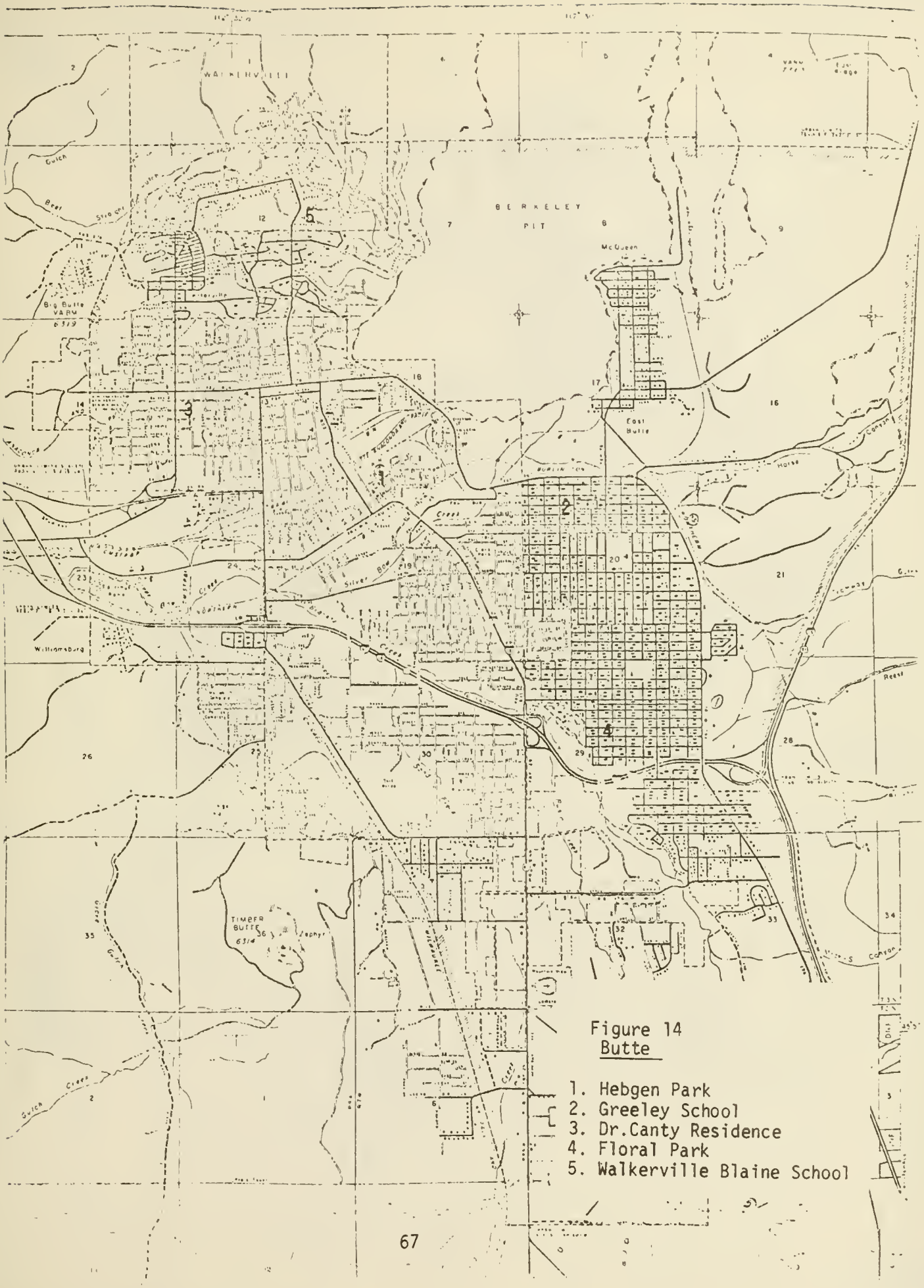
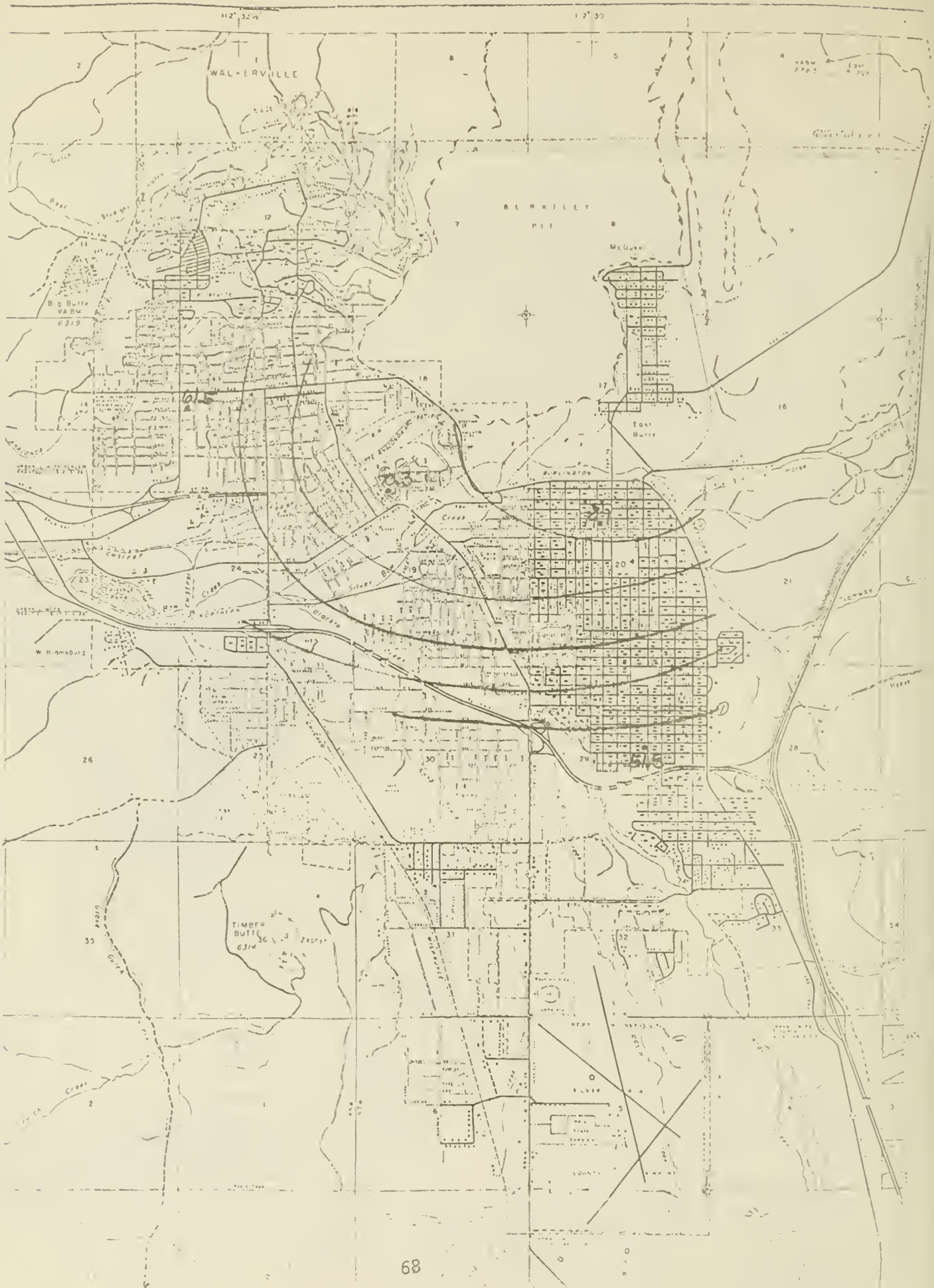


Figure 14
Butte

1. Hebgen Park
2. Greeley School
3. Dr.Canty Residence
4. Floral Park
5. Walkerville Blaine School



1979 TSP annual gmean BTM

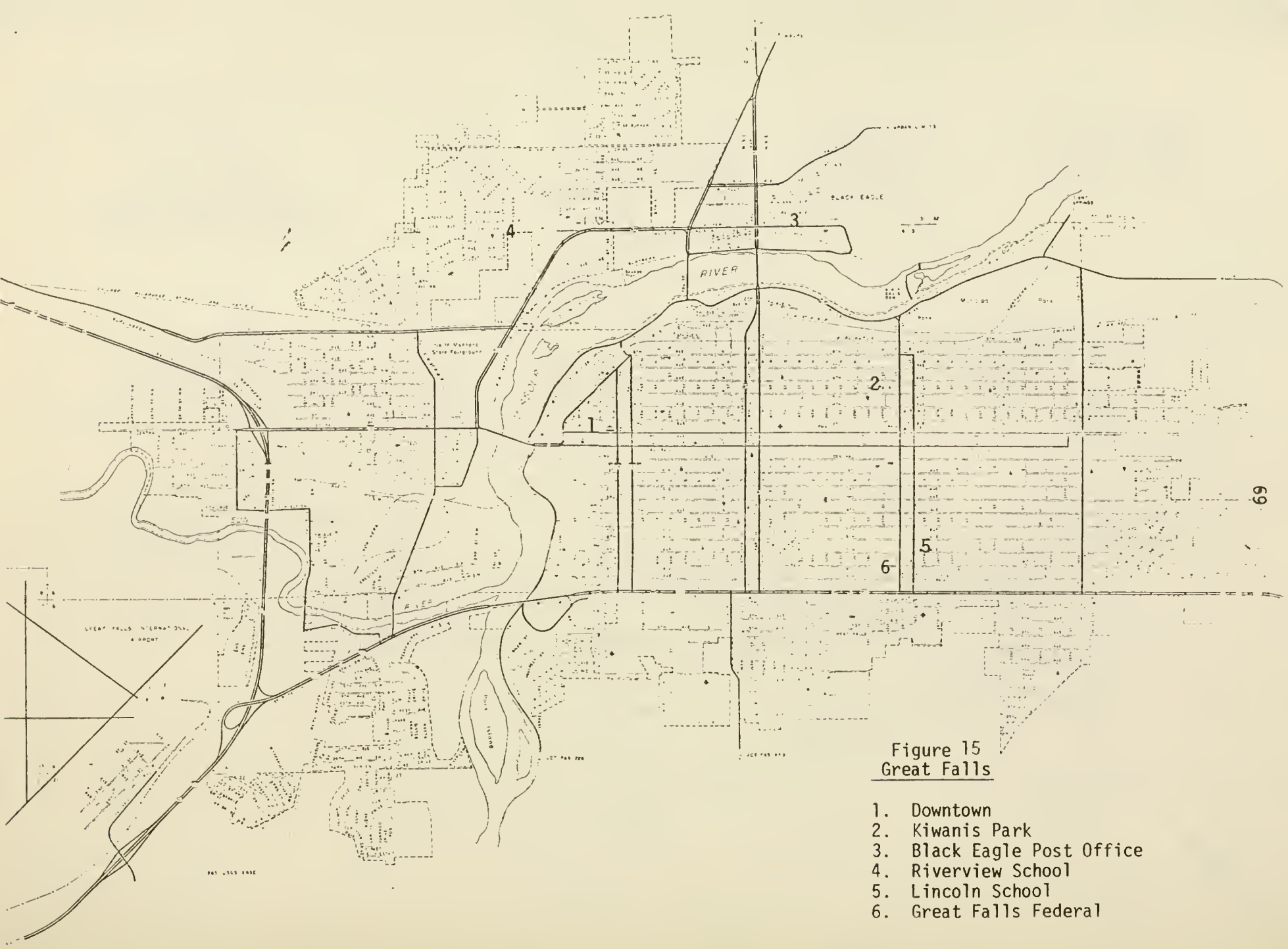


Figure 15
Great Falls

1. Downtown
2. Kiwanis Park
3. Black Eagle Post Office
4. Riverview School
5. Lincoln School
6. Great Falls Federal

43.6
43.8

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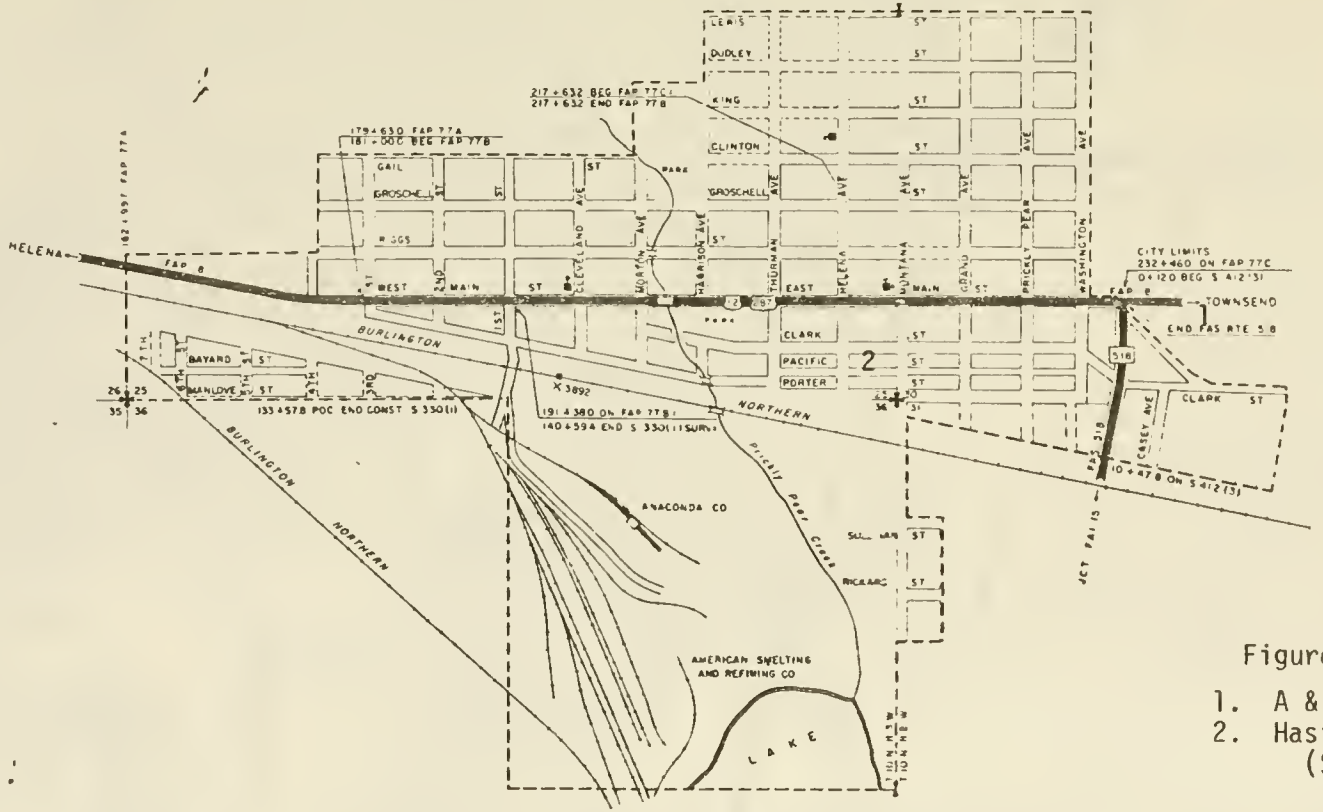

Figure 16

1. A & W (SLAMS)
2. Hastie Residence (SLAMS)

LEGEND

- PROPOSED ROAD
- GRADED AND DRAINED ROAD
- GRAVEL OR STONE ROAD
- LOW TYPE BITUMINOUS ROAD
- PAVED ROAD
- DIVIDED ROAD - TRAFFIC FLOW
- FAI FEDERAL AID INTERSTATE SYSTEM
- FAP FEDERAL AID PRIMARY SYSTEM
- FAS FEDERAL AID SECONDARY SYSTEM
- 90 INTERSTATE ROUTE MARKER
- 0 U.S NUMBERED ROUTE MARKER
- 13 STATE ROUTE MARKER
- 362 OTHER ROUTE MARKER
- CORPORATE BOUNDARY LINE
- NON EXISTENT DEDICATED STREET
- CENTRAL BUSINESS DISTRICT
- URBAN EXTENSION BOUNDARY
- RAILROAD AND STATION
- POST OFFICE
- COURT HOUSE
- ELEMENTARY SCHOOL
- HIGH SCHOOL
- HOSPITAL
- X 3000 ELEVATION

N

T 10 N R 2 W

CITY PLAT

EAST HELENA

LEWIS & CLARK COUNTY

MONTANA

1970 CENSUS 1,651

SCALE IN FEET

600 0 600 1200

REVISED DEC 1 9 9

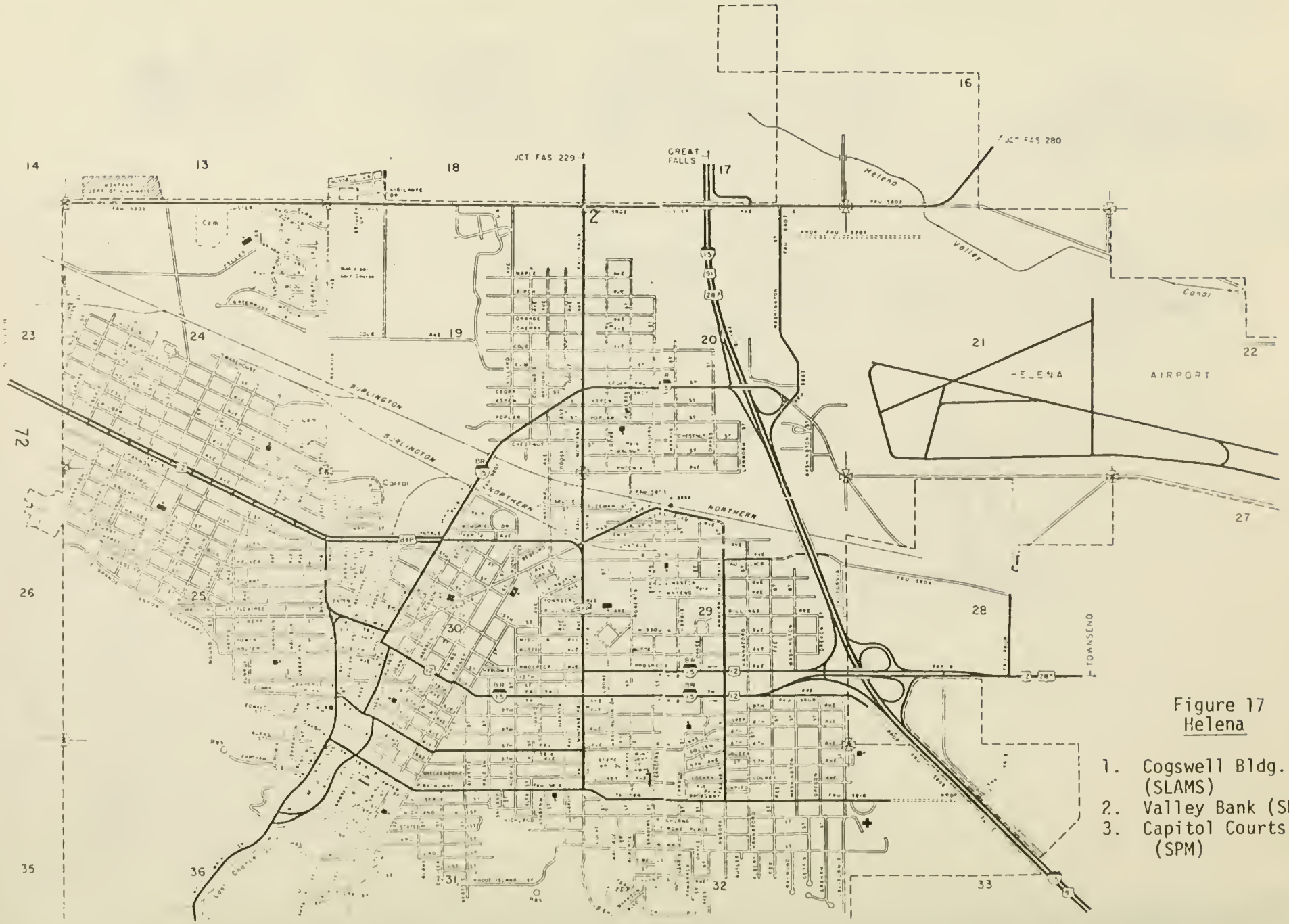

Figure 17
Helena

1. Cogswell Bldg. (SLAMS)
2. Valley Bank (SPM)
3. Capitol Courts (SPM)

Figure 18
Kalispell Area

1. Airport
2. Anders Residence
3. Dehlbohm Trailer (NAAC)
4. Universal Athletic
5. Evergreen
6. Bigfork Stine Residence

LOCATION DIAGRAM

TO GIVE A STANDARD REFERENCE ON THIS SHEET TO NEAREST 1000 METRES

100,000 M SQUARE IDENTIFICATION

NE PE QE

SAMPLE POINT STRYKER

1 Read letters identifying 100 000 metre square in which the point lies PD

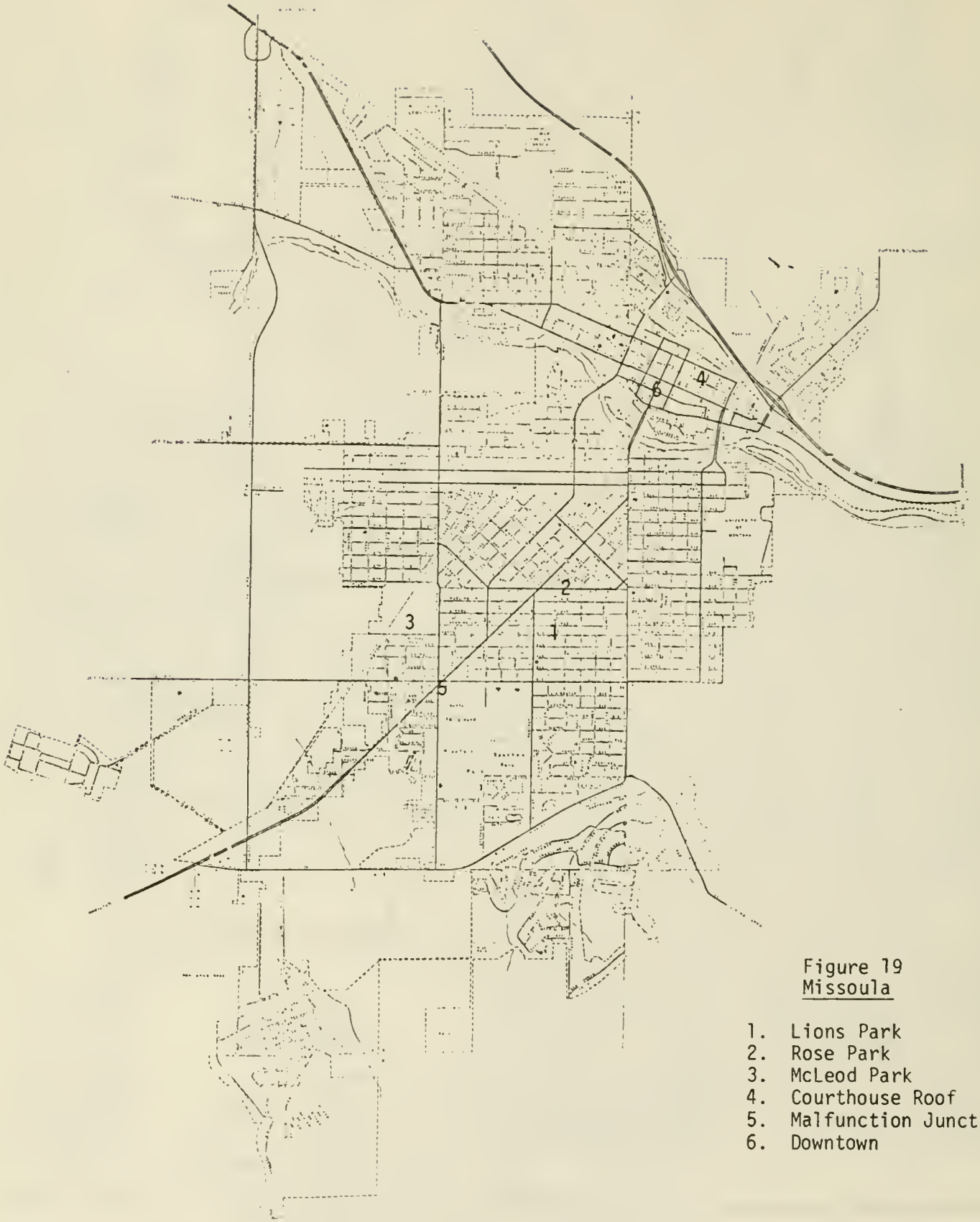

Figure 19
Missoula

1. Lions Park
2. Rose Park
3. McLeod Park
4. Courthouse Roof
5. Malfunction Junction
6. Downtown

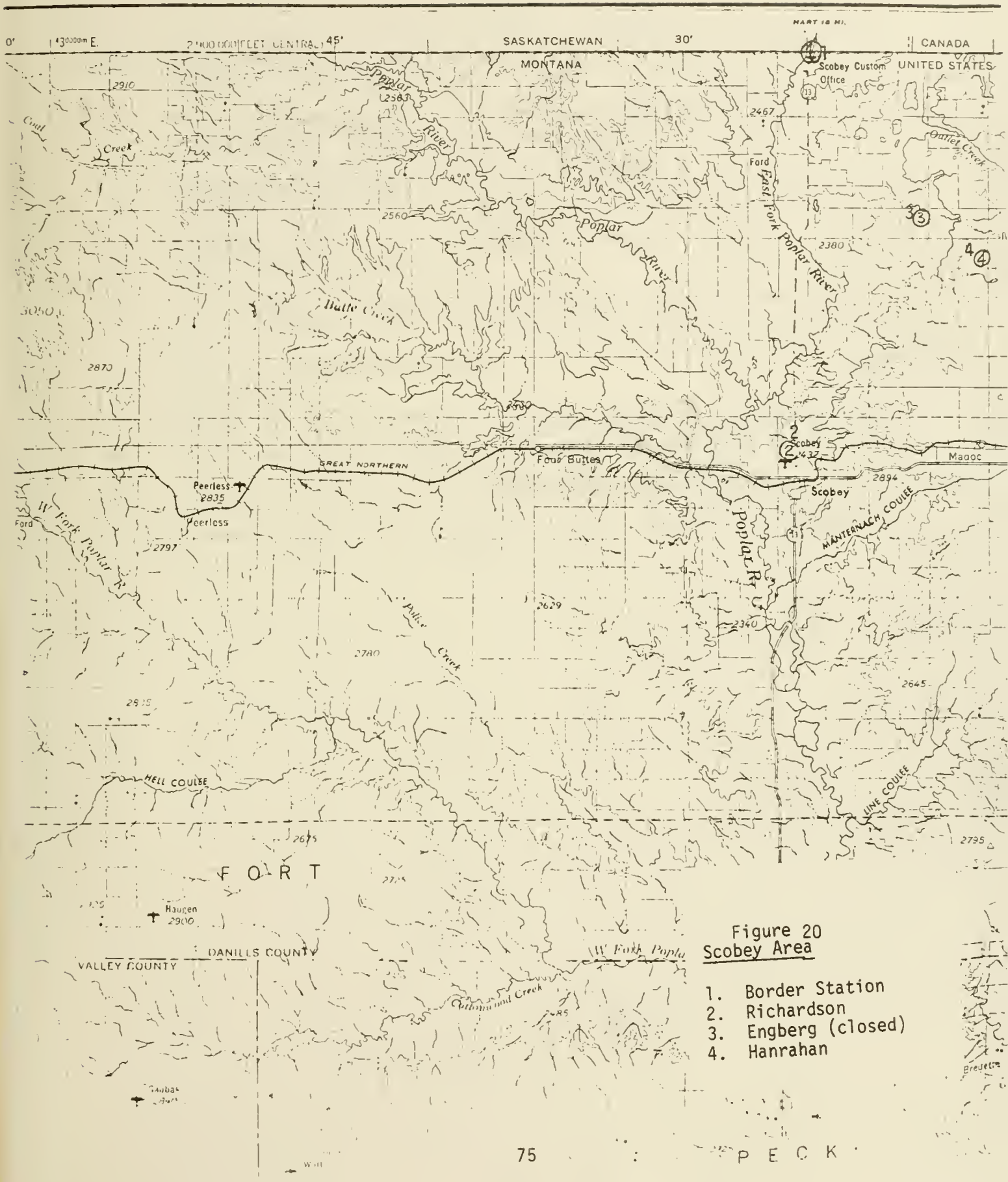

Figure 20
Scobey Area

1. Border Station
2. Richardson
3. Engberg (closed)
4. Hanrahan

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